

7002 cc. 1.

A

GENUINE AND UNIVERSAL
SYSTEM
OF
NATURAL HISTORY;
COMPRISING THE
THREE KINGDOMS OF
ANIMALS, VEGETABLES, AND MINERALS,

ARRANGED UNDER THEIR RESPECTIVE
CLASSES, ORDERS, GENERA, AND SPECIES.

By the late SIR CHARLES LINNÆUS,

PROFESSOR OF PHYSIC AND BOTANY IN THE UNIVERSITY
OF UPSAL, AND PRESIDENT OF THE ROYAL
ACADEMY AT STOCKHOLM.

IMPROVED, CORRECTED, AND ENLARGED,

By J. FRID. GMELIN, M. D.

PROFESSOR OF NATURAL HISTORY IN THE ROYAL SOCIETY
OF GOTTINGEN.

Faithfully translated, and rendered more complete by the Addition
of VAILLANT's beautiful BIRDS of AFRICA; the superb FISH
of MARK ELIEZER BLOCH; the Amphibious Animals, Rep-
tiles, Insects, &c. in the costly Works of ALBERTUS SEBA,
MERIAN, FABRICIUS, KNORR, &c. the elegant Improvements
of the Comte de BUFFON, and the more Modern Discoveries
of the BRITISH NAVIGATORS in the South Pacific Ocean, New
Holland, New South Wales, China, Cochin-China, &c.

Methodically incorporated and arranged by the EDITORS of the
ENCYCLOPÆDIA LONDINENSIS.

VOLUME THE THIRTEENTH.

L O N D O N :

PRINTED FOR THE PROPRIETOR BY LEWIS & HAMBLIN,
NO. 2, PATERNOSTER-ROW; AND SOLD BY CHAMPANTE
AND WHITROW, JEWRY-STREET, ALDGATE; AND
AT THE BRITISH DIRECTORY OFFICE,
AVE-MARIA-LANE, ST. PAUL'S.

GENERAL AND SPECIAL

AND SPECIAL

NATURAL HISTORY

THE KING OF THE

NATURAL HISTORY

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL



GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

GENERAL AND SPECIAL

AN UNIVERSAL
SYSTEM
OF
NATURAL HISTORY.

OF THE CLASS *INSECTA*, OR INSECTS.

AN investigation of the structure and economy of INSECTS is called *Insectology*; but more commonly *Entomology*; from the Greek *εντομον*, an insect; of *εν*, in, and *τιμω*, to cut, because of the cuts or indented rings on its abdomen; and *λογος*, discourse.

On the slightest view of this subject, we cannot but be struck with the extensive range which Providence has assigned to the diminutive animals, which are found to pervade the whole empire of Nature, in numbers which defy all powers of computation: and in nothing does the immensity of creation more wonderfully appear, than in the infinite variety and beauty of the insect tribes. In their manners and habitudes they form resemblances with almost every other animal; some walk like quadrupeds, or creep like reptiles; others fly like birds, while others again swim, and live in the water, like fishes. Entomology, therefore, of all the departments of natural history, presents the widest field for investigation. The number of experiments and observations necessary to furnish a complete history of so many tribes of animals, is

not only great, but the difficulty of making them is also immense. The number of ideas with which a skilful botanist must load his memory, before he can acquire an accurate knowledge of plants, is no doubt great: his task, however, bears no proportion to that of the entomologist; for, amidst so many plants, there is perhaps hardly one that does not furnish nourishment and an habitation to several insects; while many, such as the oak, afford a retreat for some hundreds of different families. Plants, however, are far from being the only abode of insects; vast numbers reside upon the larger animals, whom they continually suck; many live upon and devour others of their own kind: the earth swarms with multitudes, while the air teems with others, too numerous for the imagination to conceive!

But though a complete history of this large and populous part of nature's empire cannot be expected; yet, such a general outline may be given, as shall demonstrate the existence of that great vivifying principle by which she is animated, and by which she is enabled continually to pour forth into existence such immense numbers of organized beings. Such an inquiry will present to us a pleasing view of that protection which Providence affords even to the smallest of its creatures; of the means it employs for perpetuating them; and of that wonderful arrangement by which one set of beings subsists upon another, and by which life is renovated and held on through every part of the creation, without a pause. It is therefore extraordinary that the study of entomology should have been deemed an employment the most useless and frivolous in which the human mind can be engaged: and it is to be lamented that many have been in consequence deterred from contemplating the wonders displayed by nature, in a kingdom of animals the most numerous, diversified, and splendidly adorned, of any on the face of the globe; and hence have

have deprived themselves of views of the power and munificence of the Author of Nature, the most striking and interesting that can be presented to the mind of man.

To those, however, who even derive no pleasure from the studies of a liberal mind, and who feel no satisfaction in any employment that is not attended with immediate profit, the researches of the entomologist may not be altogether useless. Had the operations of the silkworm never been examined, how could men have availed themselves of the labour of an insect that administers so profusely to the richness and elegance of our dress? It was not to the unobserving eye that it first occurred, that the produce of that animal's labour might be converted into a considerable article of commerce, and might give rise to many arts, and afford subsistence to thousands of manufacturers. In the same manner, wax and honey enter into the articles of commerce, and add to our luxuries. It cannot, therefore, be denied, but that those naturalists were profitably employed who first observed the industry of the bee; who brought that animal from its native woods, introduced it into the hive, and, by domesticating it there, have rendered it subservient to our enjoyments.

The Chinese, whose progress in many of the arts is deservedly celebrated, avail themselves of the labours of certain insects in procuring a rich dye, and an elegant varnish, which is provided by a certain species of winged ant. Our finest red colours are also furnished by insects. The *cochineal* insect, the extensive advantages of which have been long known, is propagated with care, and in vast numbers, in the kingdom of Mexico, and in many parts of South America. The *kermes*, or grain of scarlet, which was formerly imagined to be one of the galls or excrescences that are seen on shrubs, is now found to be

be an insect, which attaches itself in that form to a species of the oak.

The medical uses of the insect tribes are also far from being inconsiderable; and to these objects they have long been applied. The valuable purposes to which the *cantharides* have been made subservient, will alone vindicate the utility of those researches which have been made concerning this part of the animal kingdom. There are still other uses to which insects have been applied, and that from the most remote antiquity, which appear of a curious and singular nature. Even before the time of Theophrastus and of Pliny, certain kinds of them were employed in ripening the figs throughout the islands of the Archipelago; and it appears from Tournefort, that the same practice still subsists among the inhabitants of those islands. There are two kinds of figs cultivated around the Mediterranean; the wild, and the domestic. The former produces fruit several times in the year; and in it are fostered certain worms, which are afterwards transformed into small flies. It is by the assistance of these little animals that the domestic fig is brought to maturity, which would otherwise drop from the tree in an unripe state. During the months of June and July, the peasants are busily employed in collecting such of the wild figs as abound most with these insects, and in placing them near the cultivated fig, that they may co-operate with nature in bringing it to maturity. Similar purposes are effected by our gardeners in England, who employ the bees on their first coming, and shut them into the frames, to transfer the prolific farina of the male blossom to that of the female, whereby fructification is insured, and early cucumbers produced.

But there are other inducements to the study of entomology, of a nature wholly different from those already mentioned; inducements, founded not on any hope of pecuniary advantage, but of alleviating or preventing

preventing the numerous mischiefs they occasion. Infinite swarms of insects annually desolate whole provinces; others attack our gardens and cultivated grounds, where they commit endless devastations upon the corn, vegetables, and fruit trees. Nor are their depredations confined to the fields; they enter the habitations of man, pierce the soundest bottoms of ships, and by destroying the timbers gradually reduce them to ruin. They injure his books and furniture, and destroy his clothing; some of them spare not even his person, tormenting it long before the period which nature has destined it to become their legitimate prey. Here, then, by a closer examination of the destructive powers of insects, we shall have melancholy proofs of their importance in the system of nature, and be persuaded that however trifling they may appear, there is no class of animals whose history more nearly concerns us, and which better deserves the attention of the naturalist.

There are four different species of the locust which are remarkably destructive. Almost every year, whole provinces, the most fertile in Asia and Africa, are laid waste by their depredation. In Tunis and Algiers, swarms of the *Gryllus migratorius* appear so numerous, that they darken the face of the sky, like a threatening cloud. These pernicious animals are wasted there by the southerly winds in the month of April. In May they take their departure for the interior parts of the country, to propagate their young; these make their appearance in their larva or caterpillar state, during the month of June, when they commit vast depredations. The first columns, which pervade the country like an army, destroy every green shrub and pile of grass; and their devastation has not ceased, when they are succeeded by other swarms, that press upon their rear, devouring the tender branches and stalks of plants, which their forerunners had left. This dreadful visitation, which the language of scripture

ture

ture has justly described as a plague, does not terminate till the insects have passed into their winged state, when they fly off, leaving the whole surface of the earth naked and brown, as if scorched by fire.

Little inferior to the locust in its destructive powers, is the *Phalæna graminis* of Linnæus, which destroys the meadows in Sweden. There the peasants are employed in cutting deep ditches in the surface to stop the progress of the larvæ as they pass along. If the swarm be small, this device has the desired effect; but the numbers of these animals are often so great, that they fill up the trenches, and pass along over the dead bodies that are buried in them. The *Formica sacchilifera* is a native of the West Indies, where it pervades the plantations of the sugar-cane, entering the plants, and destroying them when they are tender: after long experience of its depredations, the inhabitants have never been able to invent a method of destroying this pernicious animal. In our own country, the turnip-fly, the butterfly, the chafer maggot, the corn insect, *thrips physapus*, and the gooseberry-worm, have long committed depredations in the fields and gardens, which no invention has hitherto been able wholly to prevent. Another object highly worthy the attention of the entomologist, is the means of preserving corn from the invasion of insects, after it is collected into granaries. Our subsistence, in almost every stage of its progress, is constantly exposed to the intrusions of these enemies of human industry. Flour, biscuit, and almost every kind of provision, even after it is barrelled up for exportation, is liable to be devoured or rendered useless, by the depredations of the minutest animals. The patriotism of statesmen, and their zeal for the good of mankind, could not receive a nobler or more useful direction than in holding out rewards to such as might discover the most effectual means of preventing the ravages of those animals, which, by the most destructive activity, are

are continually converting large stores of provisions into so many masses of corruption.

If we pass from these evils to other inconveniences with which insects oppress the human race, we shall find room to commiserate the inhabitants of many parts of the globe. What an uncomfortable life must the poor Laplander lead, since, at certain seasons of the year, the number of insects is so great, that a candle is no sooner lighted than the flame is extinguished by the multitudes that flock to it; where, after millions are destroyed, famished millions succeed, and renew the unceasing combat. Less injurious, though equally tormenting, are the mulqueetos which infest the warm climates of Asia and South America. Even in Britain, which is happily free from these unrelenting invaders, much inconvenience is often felt from the sting of the hornet, the wasp, and the bee; and almost as bad from filthy vermin, especially the bug. To counteract these inveterate enemies of man, and to relieve him from the mischiefs they occasion, ought always to be one aim of the entomologist: and no person will deny, that whoever, by the study of insects, has found the means of availing himself of the labours of such as are useful, or prevent the noxious from doing harm, hath rendered an essential service to mankind.

After what has been said, it may appear singular, that the study of entomology was very long before it attracted any considerable degree of attention from men of learning. Aristotle, the father of naturalists, has allotted but a small portion of his works to the history of insects; nor does it appear that he has been always sufficiently attentive to the authorities upon which he inserts the different facts he relates, or to the order in which they are arranged. The histories of Pliny and Ælian are formed upon the same plan, and are liable to similar defects: they consist of a

number of observations, ill arranged, and insufficiently authenticated.

During that long succession of ages, which was only distinguished by ignorance and barbarism, entomology shared the same fate with every other science: it was condemned to oblivion. After a taste for literature had begun to revive, the history of insects again attracted the notice of the curious; unhappily, however, for the growth of science, men were then devoted to the study of the ancients with a blind admiration. It was from their writings that they imagined the moderns were to derive a complete knowledge of all the secrets of nature; and Aristotle was principally consulted for the history of animals. Had Aldrovandus, Gesner, and Mouffet, bestowed the same attention in studying the works of nature, that they employed upon the writings of ancient authors, they would have made a much greater progress in real knowledge.

The attempts of these writers, however, gave birth to the researches of others, who were gradually more bold and successful, in proportion as their reverence for antiquity was diminished. In 1668, about twelve years after Mouffet published his *Theatrum Insectorum*, the experiments and observations of the celebrated Rhedi made their appearance in Italy. His investigations were principally directed to the manner of the generation of insects, with a view to overthrow that absurd and erroneous doctrine established by the ancients, of their arising fortuitously from different bodies in a state of putrefaction. Nothing can more fully demonstrate the strength of prejudice than those elaborate treatises which Malpighi, Swammerdam, and Rhedi, were obliged to compose, in order to combat the notion of the spontaneous generation of insects; an opinion which at present seems as ridiculous and unphilosophical as it is untrue. Notwithstanding all their efforts to prove, that the smaller animals

animals are produced in the same manner with the larger, and that the organization of the body of a mite requires the same apparatus of limbs, and the same complete structure of parts, as that of an elephant, attempts were still made to revive the ancient error by Kirker, Bonarie, and others. And what is most mortifying to human reason, the same Rhedi, the declared enemy of prejudices, and the man of all others who knew best how to combat them, has, upon this very subject, fallen in a similar error. In order to produce those insects which are found upon the small excrescences of plants and trees, he conferred a vivifying power, a kind of soul, upon those vegetables where they were found, and thus laid aside the ordinary mode of generation, which in other instances he had laboured to establish.

Swammerdam was the contemporary of Rhedi; and, like him, he possessed the courage to examine nature, and think for himself. This naturalist made many anatomical experiments upon insects, which after his death were published at Leyden, and laid the foundation of great improvements in entomology. About the same period, Mary Sibille Merian, a Dutch lady, contributed largely to bring the history of insects into repute, by the beauty of her paintings and drawings. After having executed elegant figures of several of the insects of Europe, from a singular avidity for entomology she was prompted to cross the Atlantic, and give paintings of many of those in South America. Having resided for several years in Surinam, she returned to Europe with exquisite drawings of many of the splendid insects of that continent, which were afterwards engraved and published in Holland; and her work, with the original drawings, are now preserved as objects of real curiosity in the British Museum.

Goedart is another of the first authors who adorned the history of insects with the labours of the pencil.

He paid great attention to the metamorphoses of the animals, and has painted many of them in the several forms which they assume, from their appearance till their death. His work was originally published in German, very badly arranged; a new edition in Latin was afterwards given by Dr. Lister, in which many errors were corrected, and a new arrangement made out by that able naturalist, who has himself written a valuable treatise upon the intricate genus of spiders.

Some of these authors by the extent of their labours, and others by the boldness of their genius, had convinced mankind that the ancients were far from attaining that perfect knowledge of nature which they had hitherto imagined. They were now so far emboldened by the progress they had made, that they trusted to their own judgment and observation in examining the works of nature; and many productions far more judicious, accurate, and philosophical, were offered to the public, than had ever before appeared. Among the first of these may be ranked that of our celebrated countryman, Mr. Ray, who had, for the greater part of his life, assiduously examined the economy of insects. His *Methodus Insectorum* was not published till after his death in 1710, and was then the most accurate and concise performance on the subject of entomology. In the mean while, there appeared a numerous list of authors who treated on this class of the animal kingdom: Albin described the insects of England, while Sir Hans Sloane, Petiver, Catesby, and Frisch, have detailed the history of vast numbers of exotic animals of this tribe.

In this state of the science, about the year 1754, appeared M. de Reaumur, by far the most laborious and indefatigable entomologist then in Europe. Almost in every part of France this naturalist had correspondents stationed to transmit him descriptions and specimens of every curious insect that might occur. And in order to examine their instincts, their transformations,

formations, and mode of generation, he inclosed vast numbers of them in a large aviary, constructed with a close net, and secured below with a pavement overlaid with green turf, and planted with shrubs and different kinds of plants. It was there that this unwearyed observer of nature examined the manners and economy of those insects, which he has described in one of the most voluminous works that has appeared on entomology. As a writer, he is extremely diffuse, but always entertaining and instructive. The principal defect in his work is the want of a systematic arrangement, and the synonyma of other authors; a precaution that was alone able to have prevented confusion in so large a performance, and amid the vast number of insects which he has described. These defects, however, were soon after remedied by the excellent classification of the illustrious Swede, whose system will probably long continue to be a standard to all those who shall hereafter attempt to enlarge the boundaries of natural history.

Since 1715, when the *Systema Naturæ* was first published by Linnæus, various improvements were made on it by that author, who enjoyed the rare felicity, not only of seeing his works gain universal approbation, but of many opportunities of bringing them nearer to perfection. In the mean time Geoffroy, Scopoli, Wotton, Harvey, Valisnieri, and many others of considerable note, turned their attention to this interesting part of natural history; and, while they have endeavoured to improve upon the arrangement of the Swedish naturalist without success, have nevertheless added greatly to the known species of insects. Among this number De Geer, a Swedish nobleman, counsellor to the king, may be ranked in the first station: he has published a large treatise upon this subject, in which he has not only described a great number of insects with accuracy, but has indulged in philosophical remarks upon their history, which pos-
sels

less very considerable merit. For correct classification, however, and an enumeration of all the species of insects at present known, Dr. Gmelin's edition of Linnaeus, 1793; the System of Entomology, by Fabricius, 1795; and Dr. Turton's translation of Gmelin, 1800, are by far the most complete.—Besides these, a number of entomologists have appeared, who have given most elegant engravings of insects; among which are, Enorr, Roessel, Seba, Leeuwenhoek, Fueßly, Muller, Cramer, Pallas, Baker, Barbut, Harris, Wilkes, Latreille, Paykull, Coquebert, Bosch, Frisch, Clairville, Detigny, and particularly Drury. Some of these have improved this science by microscopical observation: the last elegant improvement of which has been recently given by Kanmacher, in his new edition of Mr. Adams's History of Insects, illustrated by the microscope.

Whether we turn our attention to a hot or a cold climate, it is probable that the number of insects in every country is greater than that of plants. In Sweden there have been enumerated, and pretty accurately described, about one thousand seven hundred insects, while the number of plants, though no where more accurately examined than in that kingdom, do not exceed thirteen hundred.—In the neighbourhood of Paris, there have been discovered by Geoffroy and Reaumur, upwards of one thousand four hundred insects, while the plants of the same district, which have been still more accurately examined than the insects, do not nearly amount to that number.—The British insects have never yet been either fully enumerated, or accurately described; although the plants of this island have been pretty accurately ascertained, by the indefatigable industry of Dr. Withering. Dr. Berkenhout, in his outlines of the natural history of this island, has enumerated five hundred and seventy-two different species. In all probability, a more complete investigation would discover three or perhaps
four

four times that number of British insects. The nearer any country approaches to the equator, the more numerous will the insect tribes be found. In these northerly climes, however, there is still much room left for entomological investigation and enquiry.

The different operations which insects are observed to perform, oblige the naturalists to ascribe to them a certain degree of intelligence. Yet the various processes through which they pass are so uniform, and that succession of actions which we see them exhibit are so little varied, that nature seems to have destined them to act a subordinate part in the great republic of animals. If their history sometimes represents them varying their procedure, and accommodating themselves to circumstances, the sphere of their address seems to be confined within narrow limits; and it is seldom that they attract our admiration by any unusual efforts of sagacity. The bee and the ant represent striking instances of assiduity in labour; they have, however, but one single method of operating, and, withdrawn from that, can turn to no other. A bee taken out of the hive is totally helpless and inactive; far from displaying the sagacity of the dog, it seems incapable of giving the smallest variation to its instincts. In the pursuits of the latter animal, there appears something like choice; in the labours of the former, the whole appears like necessity or compulsive instinct.

The amazing number of insects is another argument of their inferiority in the sentient principle. It is a rule which obtains among the offspring of nature, that the nobler animals are slowly produced, and that, in forming these, she acts with a dignified economy; while, in her meaner births, she is often lavish to profusion; and thousands of the more ignoble kinds are produced merely to supply the necessities of the more-favoured and highly-organized parts of her creatures. From these considerations, we are induced to

to believe that the degree of intelligence allotted to this class of the animal kingdom is but small; and our experience, as far as it does, coincides with this opinion. While other animals are capable of some degree of education, these have one invariable mode of operating, which no art can neither alter nor improve. The dog is taught to carry; the bird to sing a tune; but those insects which may be considered as completely domesticated, can by no invention be turned from their instinct. The silkworm completes its labours, and the spider constructs its web, invariably in the same manner. An existence which continues but a single season seems too short for the purposes of instruction or of learning: hence the insects are not only of a rank inferior to the larger animals, but are more nearly allied to the *vermes*, or worms, than to the classes above them. Many are attached to one vegetable, some to a single leaf, where the period of their lives is completed in a few weeks, or perhaps a few days or hours; and where the pleasures they enjoyed, or the purposes for which they were produced, are in a great measure beyond the reach of our faculties to explore.

An insect is defined to be, an animated being destitute of bones; but which, instead thereof, is covered with a very hard skin which supplies the place of ossification; has six or more feet; and breathes through spiracula, or pores placed in the side of the body: yet insects are very distinct from, and must not be confounded with, *vermæ*, or worms. Quadrupeds, birds, and fishes, have all an internal skeleton of bones, to which the muscles are affixed; but the whole interior of insects is composed of soft flesh, and the muscles are attached to an external shell, which serves the double purpose of skin and bone, completely exemplified in the crab and lobster. Insects are divided into four principal parts: the *caput*, or head; the
thorax,

thorax, or trunk; the *abdomen*, or belly; the *artus*, or limbs.

The HEAD is affixed to the thorax by a species of articulation or joint; it is the principal seat of the senses, and, as proved by Fabricius, contains the rudiments of the brain; it is furnished with a mouth, eyes, antennæ, a forehead, a throat, and stemmata. In the greater part of insects the head is distinctly divided from the thorax, but in others it coalesces with it. The head of some insects is very large compared with the size of their bodies; the proportion between the head of the same insect is not always similar; in the caterpillars with horny heads it is generally small before they moult or change their skin, but much larger after each moulting. The hardness of the exterior part of the head prevents its growth before the change; it is consequently, in proportion to the body, very small; but when the insect is disposing itself for the change, the internal substance of the head retires inwards to the first ring of the neck, where it has room to expand itself; so that when the animal quits the skin, we are surprised with a head twice the former size; and, as the insect neither eats nor grows while the head is forming, there is this further circumstance to be remarked, that the body and the head have each their particular time of growth: while the head expands and grows, the body does not grow at all: when the body increases, the head remains of the same size, without any change.

Os, the mouth, is a part of the insect to which entomologists will find it necessary to pay a very particular attention. Fabricius goes so far as to assert that, without a thorough knowledge of the mouth, its form, and various appendages, it will be impossible to discriminate with accuracy one insect from another. In the structure of the mouth considerable art and wisdom are displayed; the diversity of the figure is almost as great as the variety of species. It is usually

placed in the fore part of the head, extending somewhat downward: in the chermes, coccus, and some other insects, it is placed under the breast. In some insects, the mouth is forcipated, to catch, hold, and tear, the prey; in others, aculeated, to pierce and wound animals, and suck their blood; in others, strongly ridged jaws and teeth, to gnaw and scrape out their food, carry burdens, perforate the earth, nay the hardest wood, and even stones, for habitations and nests for their young. Others are furnished with a kind of tube, at one time moveable, at another fixed, with which they suck the juices of the flowers.

Maxillæ, the jaws, are generally two in number; in some, four; in others, more. They are sometimes placed in an horizontal, sometimes in a transverse, direction; the inner edge is serrated, or furnished with small teeth, as in the cicada, nepa, notonecta, cimex, aphid, and remarkably so in some curculionides. They move the jaws from right to left, not up and down, but sideways.

The *rostrum*, or proboscis, is a very curious and complicated organ; it is the mouth drawn out to a rigid point. In many insects of the hemiptera class, it is bent down towards the breast and belly. It has by some writers been considered as serving at once the different purposes of mouth; nose, and windpipe, enabling the insect to extract the juices of plants, communicate the sensation of smelling, and convey air to the body.

Lingua, the tongue, is a taper and compact instrument, by which the insect obtains the juices of plants. Some can contract or expand it, others roll it up with dexterity; in some it is inclosed within a sheath. It is taper and spiral in the butterfly, tubular and fleshy in the fly; in all affording under the microscope a most singular display of curious mechanism. Swammerdam, when speaking of the proboscis of the butterfly, is full of admiration: "I cannot

not refrain (says he) from confessing, to the glory of the Immense and Incomprehensible Architect, that I have but imperfectly described and represented this small organ; for, to represent it to the life in its full perfection, as truly most perfect it is, far exceeds the utmost efforts of human knowledge." Reaumur breaks out into similar expressions, on describing the proboscis of the bee, with which they take their nourishment, and collect the honey. The proboscis of the bee is shaped like a barbed javelin, but that of the butterfly is a spiral substance, somewhat resembling the spring of a watch when wound up; as may be seen in the butterfly, in the Entomology Plate I. fig. 6. By means of a pin it can be gently pulled out to its full length; it grows gradually tapering from the base, at the end it divides or separates into two tubes, each furnished with little organs of suction probably, it is by these that it extracts the juices on which it feeds, and not by the extreme ends of the tongue. As the butterfly has no mouth, the proboscis is the only alimentary organ; when separated from the insect, it will often unroll itself, then wind and coil itself up again, continuing these motions at intervals for a considerable time.

The proboscis of the *tabanus*, or ox-fly, is also of a very singular and curious structure. The whole apparatus is composed of six parts, exclusive of the two guards or feelers, all of which are inclosed in a fleshy case, which opens at the will of the animal, and lets out its weapon, whenever disposed to pierce the hides of cattle, and suck their blood. But the most singular and curious conformation of a proboscis, if it may be so called, is the inflated projection of the head of the lantern-fly, which, in luminous splendour, so far exceeds the resulgence of the glow-worm, as to enable the inhabitants of South America to read by its light, and travellers are even said to be

directed on their journey, by fixing one or two of them to the end of a stick.

The *antennæ* are fine slender horns, consisting of several articulations, moveable in various directions, and constituting one of the discriminating characteristics of insects. They are beautiful in form, and of a very delicate structure, so finely articulated, and so minutely jointed, as to be instantaneously moveable in every direction. They are situated on the fore part of the head. The shape, the length, the number, and kind, of articulations, not only vary in different species, but the *antennæ* of the male generally differ from those of the female. The greater number of insects have only two *antennæ*, but the *Oniscus*, the *Pagurus*, and *Astacus*, have four. Regular rows of minute holes are observable in the *antennæ*, which are supposed to be nasal apertures, possessing the faculty of scent. Several insects cover their eyes with the *antennæ* while they sleep. But we are far from being certain of the positive use of this instrument; some writers have merely conjectured that they are the organs of smell and of hearing; others have supposed them appropriated to a delicate kind of feeling, sensible to the least motion or disturbance in the circumambient fluid in which they move. It is very reasonable to suppose they are the organs of smelling, since we evidently find that many insects possess this sense in a very exquisite degree; and yet we see no external organs except these to serve that purpose. The following observations may serve to throw some light on this obscure subject. When a wingless insect is placed at the end of a twig, or in any other situation where it meets with a vacuity, it moves the *antennæ* backward and forward, elevates and depresses them from side to side, and will not advance further lest it should fall. Place a stick or any other substance near the *antennæ*, and the insect immediately applies them to this new object, seems to examine whether

whether it be sufficient to support its weight, and then proceeds on its journey. From these observations it would appear that the antennæ assist the insect in judging of the vicinity of objects, and probably enable them to walk with safety in the dark.

That these observations are not, however, conclusive, appears from an experiment of a very ingenious naturalist: being desirous of ascertaining the nature and use of the antennæ and proboscis of a butterfly, he gently approached one that was flying about in search of food; he observed that it turned the antennæ about every way, till, coming within scent of a flower, it kept them fixedly bent toward that object, directing its course by their guidance, till it arrived at the flower; there they appeared to act as an organ of smell, and that the minute holes with which it is furnished assisted in promoting this operation. When the creature had reached the flower, it hovered over it as with rapture, poising itself quietly upon wing, like a kite or hawk in the air; it then dropped suddenly, till it was on a level with the flower, when it began to agitate its wings briskly, and to unroll its spiral trunk, thrusting it to the bottom of the flower; in a little time the trunk was rolled up, and again in a moment unrolled; these operations it repeated till the flower yielded no more juices; the butterfly then sought for and alighted on another. But after all, this subject must for the present remain undecided. Indeed, the bodies of insects are throughout formed of parts so different from ours, that we can probably conceive no more idea of the use of some of their organs, than a man born blind or deaf can of the senses of vision or hearing. They may have senses different from ours, and these may be the instruments of them.

The differences in the form and construction of the antennæ, are distinguished in entomology by the following names:—*Setaceous*, are those formed like a bristle,

bristle, gradually tapering towards the point or extremity, as in many places of the phalænæ. *Filiform*, are thread-shaped, and of an uniform thickness. *Moniliform*, are also of a regular thickness, but are made up of a series of minute knobs, resembling a necklace of beads, as in the Chrysomela. *Clavate*, formed like a club, increasing gradually from the base to the extremity, as in the papilio, or butterfly. *Capitate*, also formed like a club, but the last articulation is larger than the rest, finishing with a kind of knob or head. *Fissile*, are like the former, only that the capitulum or knob is divided longitudinally into three or four parts or laminæ, as in the Scarabæi. *Perfoliate*, are also capitated, but have the knob divided horizontally, and the laminæ connected by a kind of thread passing through their centre, as in the Dermestes and Dytiscus. *Pectinate*, so called from their similitude to a comb, though they more properly resemble a feather, as in the Phalænæ and Elateres; this is most obvious in the male. *Aristate*, are such as have a lateral hair, which is either naked, or furnished with smaller hairs, as in the fly.—Besides the foregoing terms, the antennæ are called *breviores*, or short, when they are shorter than the body; *mediocres*, or middling, when they are of the same length; and *longiores*, when they are longer.

Near the mouth there is also a species of small filiform articulated antennæ, called the *palpi*, or feelers; they are generally four in number, sometimes six; they are placed under and at the sides of the mouth, which situation, together with their size, sufficiently distinguish them from the antennæ; they are in continual motion, the animal thrusting them in every matter, as a hog would its nose, when in search of food. Some have supposed them to be a kind of hand to assist in holding the food when it is near the mouth.

The structure of the eye has always been considered
as

as a wonderful piece of mechanism; the admirable manner in which those of the human species are formed, and the nature of vision, are speculations which cannot but excite the attention of every inquisitive mind. The eyes of insects, though they differ considerably in their construction from those of other animals, are no less worthy of our admiration. Indeed, among the exterior parts of insects, none are more deserving of minute investigation, and very few persons can be insensible to the beauties of this organ when exhibited under the microscope; which is the only means of discovering the prodigious art employed in their organization, and evidently shows how many curious objects escape the unassisted sight. The construction of the eye in insects is not only distinct from that of other animals, but also differs in different species. They vary in number, situation, connection, and figure. In other creatures the eyes are moveable, and two in number, one on each side of the head: in insects, the genus of *Cancris* excepted, the eyes are fixed; they have no eye-brows, but the outer coating is hard and transparent. The greater part of insects have two eyes; in the *monoculus* they approach so near to each other, as to appear like one: the *gyrinus* has four eyes, the scorpion six, the spider eight, and the *scolopendra* three. Of these eyes some have them single, that is, placed in facets at a small distance from each other; while others are furnished with an indefinite number of lenses all placed in one common case or socket; and termed *reticulated* eyes. These appear like protuberances on the heads of insects, and we can perceive that they consist of a number of lines crossing each other like the meshes of a net. By this we know that they are reticulated substances; but in what manner they are so, can only be shewn by the microscope.

The eyes of the *libellula*, or dragon-fly, are divided into a number of hexagonal cells, each of which forms

forms a complete eye. The external parts of these eyes are so perfectly smooth, and so well polished, that, when viewed as opake objects, they will, like so many mirrors, reflect the images of all the surrounding objects. The figure of a candle may be seen on their surface multiplied almost to infinity, shifting its beam to each eye, according to the motion given by the hand of the observer. Other creatures are obliged to turn their eyes towards the object they desire to see; but insects have eyes directed thereto, on whatsoever side it may appear; they more than realize the romantic accounts of fabulous history; poets gave to Argus an hundred eyes; insects are furnished with thousands, having the benefit of vision on every side with the utmost ease and speed, though without any motion of the eye, or flexion of the neck. Each of these protuberances, in its natural state, is a body cut into a number of faces, like an artificial multiplying glass; but with this superiority in the workmanship, that, as there every face is plane, here every one is convex, immensely more numerous, and contained in a much smaller space. Each of the eyes is an hexagon, varying in size according to its situation in the head, and each of them is a distinct convex lens, and has the same effect in forming the image of an object placed before it.

Hooke, Catalan, and other entomologists, have shewn that these small eyes are furnished with every requisite of vision, and that each of them has the use, the power, and properties, of an eye. But we must have recourse to the works of Swammerdam for a full account of the astonishing organization of the eyes of insects. Among other things, he has shewn, that under each facet there is a pyramid of fibres broad at the base, and growing smaller as it proceeds inwards; the pyramid has the same number of sides as the eye, and there are as many hexagonal pyramids as there are small facets or eyes in the insect.

sect. Innumerable pulmonary tubes ascend these fibres, terminating in a white fibrous convex membrane; under these membranes there is another, still more delicate and transparent; beneath this, a second species of fibres is transversely applied, like so many beams to support the pyramids that are laid upon them. Still we cannot determine with certainty, how these numerous inlets to sight operate for the service of the animal; they may increase the field of view, augment the intensity of light, and be productive of advantages of which we can have no conception. Hooke computed 14,000 of these facets in the two eyes of a drone; Leeuwenhoek reckoned 6036 in the two eyes of a silkworm, when in its fly state; in the eyes of the libellula he reckoned 12,544 hexangular lenses. Swammerdam covered the reticulated eyes of certain insects with black paint; in this state they flew at random, and seemed to be deprived of their strength; when they settled, they did not avoid the hand that was going to take hold of them. Reaumur made similar experiments on the eyes of bees, which concurred with those of Swammerdam.

Some ephimera flies have four reticulated eyes, two of which are placed as in the common fly; the other two are placed, one beside the other, upon the upper part of the head, and have the appearance of a kind of mushroom, the head extended somewhat beyond the stalk. The first pair are of a brown colour, those of the mushroom form are of a very beautiful citron colour. In many of the fly class, these reticulated eyes are little inferior in colour and brilliance to the brightest gem. The colour varies in different species; in some we find it green, in others red, &c. some have a most elegant changeable colour thrown over them, partly purple, partly green, and partly of that brassy hue which is seen on the backs of some of the beetles, and which is not equalled by any other production of art or nature.

It might be imagined, that as every fly has two reticulated eyes, they could not have occasion for more; but so it has not appeared to that Great Being who formed them, for many are furnished besides with other eyes, differing in form and construction from those that are reticulated. These were first noticed by M. de la Hire; they are three lucid protuberances placed on the back part of the head of many insects; their surface is glossy, of an hemispheric figure, and a coal-black colour. They are transparent, and disposed in a triangular form; by modern entomologists they are termed *stemmata*. Reaumur made experiments upon these eyes, similar to those he had made on the reticulated ones, and found that when the *stemmata* were covered with dark varnish, the insects flew but to a small distance, and always at random. No insect seems to possess both kinds of eyes, unless in its perfect state: there are many species which are not furnished with *stemmata*, as gnats and tipulæ. But the most extraordinary construction of the eye perhaps in the whole tribe of insects, is that of the *diopsis*, or spectacle-fly. In this insect the eyes are placed on the extremity of two long, solid, inarticulate, filiform, horns; the extremities of which form a kind of socket to receive the eyes, which are spherical, and lucid black.

BODY.—The trunk or body of the insect is situated between the head and the abdomen. Entomologists divide it into three parts: the thorax, scutellum, and sternum. The *thorax* is the part of the body next the head, and is of various shapes and proportions; the sides and back of it are often armed with points. The *scutellum*, or escutcheon, covers the part between the thorax and abdomen, and is generally of a triangular form; though it adheres to the thorax, it is easily distinguished from it by its figure, and often by an intervening suture. It seems intended to assist in expanding the wings. The sternum is situated on the

the under part of the thorax; in some species it is pointed behind, as in the elateres; in others, bifid, as in some of the dytisci. In short, the thorax is the stomach of insects; and is either round, triangular, cylindrical, thick, slender, &c. It may be considered as composed of six faces, like a cube, which form it sometimes assumes, and is often terminated by a kind of border, and then called *marginated*.

ABDOMEN.—The abdomen contains the intestines, air-vessels, &c. It is composed of several corneous rings or segments, so that it may be moved in various directions, or lengthened and shortened at pleasure; in some it is formed of one piece only. It is perforated with spiraculi, or breathing holes, and is terminated by the tail. The *spiraculi* are small oblong holes or pores placed singly one on each side of every ring or segment; these are the means or instruments of respiration, which supply the want of lungs, and form a peculiar characteristic of insects. The organs of generation are placed in the extremity of the abdomen.

LIMBS.—By the limbs are meant the instruments used by the insect both for motion and defence. They are, *alæ*, the wings; *halteres*, the poisers; *pedes*, the legs; *cauda*, the tail; and *aculeus*, the sting.

The *wings* are those instruments by which the insect is enabled to fly; some have only two, others are furnished with four, two on each side; these are, in some, of the same size; in others, the superior ones are much larger than the inferior: Linnæus has made them the foundation of the seven orders into which he has divided this numerous class of beings. The variety in the form and structure of the wings is almost infinite; the beauty of their colouring, the art with which they are connected to the body, the delicate manner in which some are folded up, the fine articulations provided for this purpose, by which they are laid in their cases when out of use, and yet ready

to be extended in a moment for flight, afford an inexhaustible fund of curious investigation. The wings of moths and butterflies are mostly farinaceous, covered with a fine dust, which, by the assistance of the microscope, appears to be a regular assemblage of organized scales.

The following terms are applied to the different kinds of wings. They are first distinguished, with respect to their surfaces, into superior and inferior. The part next the head is called the anterior part; that nearer the tail, the posterior part. The interior part is that next the abdomen; the exterior part is the outermost edge. Those wings are termed *plicate*, which are folded when the insect is at rest, as in the wasp. *Plane*, when incapable of being folded. *Erect*, when the superior surfaces are brought in contact when the insect is at rest, as in the ephemera, papilionæ, &c. *Patent*, if extended horizontally when the insect is at rest, as in the *Phalænæ geometræ*. *Incumbent*, if when they are not in motion, they cover horizontally the superior part of the abdomen. *Deflexed*, are also incumbent, but not horizontally, when the outer edges decline towards the sides. *Reverse*, are also deflexed, with this addition, that the edges of the inferior wings project from under the anterior part of the superior ones. *Dentate*, when with ferrate or scolloped edges. *Caudate*, when the fibres of the wings are extended beyond the margin into a kind of tail. *Reticulate*, when the veins or membranes of the wings put on the appearance of net-work.

The wings are further distinguished by their ornaments: when painted with spots, *maculæ*; bands, *fasciæ*; streaks, *strigæ*: when these are extended lengthways, they are called lines, *lineæ*; and if with dots, *punctæ*; one or more rings or spots are termed eyes, *ocelli*; if the spots are shaped like a kidney, they are termed *stigmata*. These spots or eyes are most common to the wings of the butterfly.

The

The *elytra*, or crustaceous shells or cases of the wings, are extended when the insect flies, and shut when it rests, forming a longitudinal suture down the middle of the back; they are of various shapes, and distinguished by the following names:—*Abbreviate*, when shorter than the abdomen. *Truncate*, when their extremities terminate in a transverse direct line. *Fastigate*, when of equal or greater length than the abdomen, and terminating in a transverse line. *Serrate*, or *toothed*, having their external margins edged with teeth or notches. *Spinose*, when their exterior surfaces are covered with small sharp points. *Scabrous*, when very rough. *Striate*, when marked with slender longitudinal furrows. *Porcate*, having sharp longitudinal ridges. *Sulcate*, with deep furrows. They are likewise distinguished by the denomination of *heme-lytra*, when their cases are neither so hard as the elytra, nor so delicate as the transparent wings.

Under the wings of most insects which have only two, there is a small head placed on a stalk, frequently under a little arched scale; these are called *halteres*, or poisers; they appear to be rudiments of the hinder wings: it has been supposed that they serve to keep the body in equilibrio when the insect is flying.

The elytra, or exterior cases, are much harder and more opaque than the wings under them; they are generally highly polished, and often enriched with various colours, adorned with ornamental flutings, and studded with brilliants whose beauties are beyond description. All these ornaments are united in the *Curculio imperialis*, or diamond beetle, one of the richest and most magnificent creatures in nature; the head, the wings, the legs, &c. are curiously beset with scales of a most splendid appearance, outvying the ruby, sapphire, and emerald, forming, under the microscope, one of the most noble phenomena that the colours of light can exhibit. It is said, that in
the

the Brazils, from whence they come, it is almost impossible to look at them on a sunny day, when they are flying in little swarms, so great is the glowing splendour of their heightened colours.

The strength and hardness of the elytra are admirably adapted to the various purposes of the insects to which they are appropriated; at the same time that they protect the tender wings beneath them, they serve as a shield to the body; while the ribs, and other prominences, contribute to lessen the friction and diminish the pressure to which they are often exposed. In most of these insects, the under wing is longer and larger than the exterior shell, so that it is obliged to be bent and folded up, in order to lie under the elytra; for this purpose they are furnished with strong muscles, and proper articulations to display or conceal them at pleasure.

The wings of moths and butterflies are mostly imbricate or farinaceous, being covered with a fine dust, which renders them opaque, and produces those beautiful and variegated colours by which they are so profusely decked. If this be wiped off, we find the naked wing to consist of a number of ribs, like those in the leaves of plants, but of a crustaceous nature; the largest rib runs along and fortifies the exterior edge of the wing; the interior edge is strengthened by a smaller vessel or rib. The ribs are all hollow, by which means the wing, though comparatively large, is very light. The membrane between the ribs, which constitutes the body of the wing, is surprisingly thin and transparent; and as this is extremely tender, one use of the scales may be to protect it from injuries. When the moth emerges from the chrysalis, the wings are soft and thick, and if they be examined in that state, will be found to consist of two membranes, that may be raised up and separated, by blowing between them with a small tube: the ribs lie between these membranes. With the assistance of glasses we discover

discover certain straight and circular rows of extremely minute holes, running from rib to rib, or forming figures in the intermediate spaces, which seem to answer to the figures and variegations on the complete wing, and are probably the sockets for the stalks or stems of the small scales.

The *legs* are found to vary greatly in different insects. The most general number is six; many of the class aptera have eight, as the spider; the hornet has ten; the *oniscus* or wood-louse fourteen; the *julus* has from seventy to a hundred and twenty on each side. The legs of those insects that have not more than ten, are affixed to the trunk, while those that exceed that number, have part fixed to the trunk, the rest to the abdomen. The legs of insects are divided into four parts. The first, which is usually the largest, and connected to the body, is called the *femur*; the second, or *tibia*, is joined to the former, and is commonly of the same size throughout, and longer than the femur; this is followed by the third part, which is distinguished by the name of *tarsus*, or foot; it is composed of several joints, the one articulated to the other, the number of rings varying in different insects; the tarsus is terminated by the *unguis*, or claw.

Entomologists, in order to render their descriptions clear and accurate, have given several names to the legs of insects, from the nature of the motions produced by them. Thus *cursorii*, from that of running; these are the most numerous. The *saltatorii*, those that are used for leaping; the thighs of these are remarkably large, by which means they possess considerable strength and power to leap to great distances; as the grasshopper. The *natatorii*, those that serve as oars for swimming; the feet of these are flat, and edged with hair, possessing a proper surface to strike against the water; as in the dytiscus, notonesta, &c. Such feet as have no claws are termed *mutici*.

The

The *chela*, or claws, are an enlargement of the extremity of the fore feet, each of which is furnished with two claws, which act like a thumb and finger, as in the crab; and are called *chelate*. The under part of the feet in some insects is covered with a kind of brush or sponge; by which they are enabled to walk with ease, on the most polished substances, such as panes of glass, in every direction.

Many insects can only move the thigh in a vertical direction, while others can move it in a variety of ways. The progressive motion of insects, and the various methods employed to effect it, will be found a very curious and important subject, and well worthy the attention of the naturalist. The intelligent mechanic may not find it lost labour if he bestow some time on the same subject. Very little has been done on this head, and that principally by Reaumur, in his excellent Memoirs; and by M. Weils, in a Memoir published in the Journal de Physique for 1771. The reader may also consult Borelli de Motu Animalium.

Cauda, the tail, terminates the abdomen, and is constructed in a wonderful manner for answering the purposes for which it is formed, namely, to direct the motion of the insect, to serve as an instrument of defence, or for depositing its eggs; the figure and size thereof varying in each genus and its species, and mostly different in the male and female, and thus serving to distinguish the sexes. In most insects it is simple, and yet capable of being extended or drawn back at pleasure; in others elongated, as in the crab and scorpion; or shaped like a bristle, as in the raphidia; or with three appendages like bristles, as in the ephemera; in some it is forked, as in the podura; and in others it is furnished with a pair of forceps, as in the earwig; in the blatta, grylli, and others, it is foliose, or like a leaf; in the scorpion and panorpa it is furnished with a dart or sting.

Aculeus, the sting, is an instrument with which insects

sects wound and instil a poison; the sting generally proceeds from the under part of the last ring of the belly; in some it is sharp and pointed, in others serrated, or formed like a saw. It is used by many insects both as an offensive and defensive weapon; by others it is only used to pierce the substances where they mean to deposit their eggs. This instrument cannot be properly seen or known, but with the assistance of a microscope. Of bees, it is only the neuters and the queens that have stings. The apparatus is of a very curious construction, fitted for inflicting a wound, and at the same time conveying poison into that wound.

It has already been observed, that the bodies of insects are covered with a hard skin, answering the purpose of an internal skeleton, and forming one of the characters by which they are distinguished from other animals. This external covering is very strong in those insects which, from their manner of life, are particularly liable to great friction, or violent compression; but is more tender and delicate in such as are not so exposed. Another distinguishing criterion of insects is the colour of their circulating fluid, or blood, which is never red; this, at first sight, seems liable to some objections, on account of the drop of red liquor which is often procured from small insects when squeezed to pieces. It does not appear, however, that this is the blood of the animal; when it existed as a worm there was no such appearance; and, when transformed to the perfect or fly state, it is only found in the eye, and not in the body, which would be the case if it circulated in the veins of the insect. It is probable there is a circulation of some fluid analogous to the blood in most insects: with the assistance of the microscope this circulation may be perceived in many; but the circulating liquor is not red.

Insects are distinguished from other animals by
VOL. XIII. No. 165. E the

the wonderful *transformations* that all those of the winged species without exception, and some which are destitute of wings, necessarily pass through, before they can arrive at the perfection of their nature.

Most animals retain, during their whole life, the same form which they receive at their birth ; but insects go through various exterior and interior changes, insomuch that the same individual, at its birth and middle state, differs essentially from that under which it appears when arrived at a state of maturity ; and this difference is not confined to marks, colour, or texture, but is extended to their form, proportion, motion, organs, and habits of life. It was not till towards the latter end of the seventeenth century, that any just conception of this subject was formed. By dissection just before their changes, it was readily seen that the moth and butterfly grow and strengthen themselves, that their members are formed and unfolded under the figure of the insect we call a caterpillar, and that the growth is effected by a development of parts ; consequently the changes which are apparently sudden to our eyes, are gradually formed under the skin of the animal, and only appear sudden to us, because the insect then gets rid of a case which had before concealed its members. By this case it is preserved from injuries, till its wings, and every other part of its delicate frame, are in a condition to bear the impulse of the sun, and the action of the air ; and when all the parts are grown firm, and ready to perform their several offices, the perfect animal appears in the form of its parents.

These transformations clearly prove, that without experience every thing in nature would appear a mystery ; so much so, that a person unacquainted with the transformation of the caterpillar to the chrysalis, and of this to the fly, would consider them as three distinct species of insects ; for who, by the mere light of reason unaided by experience, could believe

believe that a butterfly, adorned with four beautiful wings, furnished with a long spiral proboscis or tongue, instead of a mouth, and with six legs, proceeded from a hairy caterpillar, provided with jaws and teeth, and fourteen feet? Without experience, who could imagine that a long white soft worm hid under the earth, should be transformed into a crustaceous chafer? Nor could any one, from considering them in their perfect state, have discovered the relation which they bear to the corresponding forms through which they have passed, and which are to appearance as distinct as difference can make them.

The life of those insects which pass through these various changes, may be divided into four principal states. The first change is from the *egg* into the *larva*; or as it is more generally called, into the worm or caterpillar. From the *larva* it passes into the *pupa* or chrysalis state. From the *pupa*, into the *imago* or fly state.

Few subjects are more expressive of the extensive goodness of Divine Providence, than these transformations, in which we find the temporary parts and organs of these little animals suited and adapted with the most minute exactness to the manner of their existence; which again are shifted and changed, upon the insects commencing a new scene and state of action. In its larva state, the insect appears groveling, heavy, and voracious, in the form of a worm, with a long body composed of successive rings; crawling along by the assistance of these, or small little hooks, which are placed on the side of the body. Its head is armed with strong jaws, its eyes smooth, entirely deprived of sex, the blood circulating from the hind part towards the head. It breathes through small apertures, which are situated on each side of the body, or through one or more tubes placed in the hinder part thereof. While it is in the larva state, the insect is as it were masked, and its true ap-

pearance concealed; for under this mask the more perfect form is hidden from the human eye. In the pupa or chrysalis state, the insect may be compared to a child in swaddling clothes; its members are all folded together under the breast, and inclosed within one or more coverings, remaining there without motion. While in this state, no insects but those of the hemiptera class take any nourishment. The change is effected various ways: in some insects the skin of the larva opens, and leaves a passage, with all its integuments; in others, the skin hardens and becomes a species of cone, which entirely conceals the insect; others form or spin cones for themselves, and in this state they remain till the parts have acquired sufficient firmness, and are ready to perform their several offices. The insect then casts off the spoils of its former state, wakes from a death-like inactivity, breaks the inclosures of its tomb, throws off the dusky shroud, and appears in its image or perfect form; for it has now attained the state of organical perfection, which answers to the rank it is to hold in the corporeal world: the structure of the body, the alimentary organs, and those of motion, are materially changed. It is now furnished with organs of generation, and with wings magnificently adorned; it soars above its former pursuits, plays in the genial air, chooses its mate, and transmits its nature to a succeeding race. Those members, which in the preceding state were wrapped up, soft, and motionless, now display themselves, grow strong, and are put in exercise. The interior changes are as considerable as those of the exterior form, and that in proportion as the first state differs from the last; some organs acquire greater strength and firmness, others are rendered more delicate; some are suppressed, and some unfolded, which did not appear to exist in the former stages of its life.

The greater part of those insects which come forth
in

in spring or summer, perish at the approach of winter; there are very few, the period of whose life exceeds that of a year; those which survive the rigours of winter, are buried under ground; many are hid in the bark of trees, and others in the chinks of old walls; some, like the caterpillar of the brown-tailed moth, at the approach of winter secure and strengthen the web in which the society inhabit, and thus protect themselves, till the spring animates them to new life. Many that are hatched in the autumn, retire and live under the earth during the winter months, but in the spring come out, feed, and proceed onward to their several changes; while no small part pass the colder months in their chrysalis or pupa state: but the greater number of the caterpillar race remain in the egg, being carefully deposited by the parent fly in those places where they may be hatched with the greatest safety; in this state the latent principle of life is preserved till the genial influence of the spring calls it into action, and brings forth the young insect to share the banquet that nature there provides.

All caterpillars are hatched from the egg, and when they first proceed from it are generally small and feeble, but grow in strength as they increase in size. The body is divided into twelve rings; the head is connected with the first, and is hard and crustaceous. No caterpillar of the moth or butterfly has less than eight, or more than sixteen, feet; the six first are crustaceous, pointed, and fixed to the three first rings of the body; these feet are the covering to the six future feet of the moth; the other six feet are soft and flexible or membranaceous; they vary both in figure and number, and are proper only to the larva state; with respect to their external figure, they are either smooth or hairy, soft to the touch, or hard like shagreen, beautifully adorned with a great variety of the most lively tints; on each side of the body nine
stigmata,

stigmata, or little oval holes, are placed, which are generally considered as the organs of respiration. There are on each side of the head of the caterpillar five or six little black spots, which are supposed to be its eyes. These creatures vary in size, from half an inch long to four and five inches.

The caterpillar, whose life is one continued succession of changes, often moults its skin before it attains its full growth; not one of them arrives at perfection without having cast its skin twice or thrice. These changes are the more remarkable, because when the caterpillar moults, it is not simply the skin that is changed; for we find in the exuvia, the skull, the jaws, and all the exterior parts, both scaly and membranaceous, which compose its upper and under lip, its antennæ, palpi, and even those crustaceous pieces within the head which serve as a fixed basis to a number of muscles; we further find in the exuvia, the spiracula, the claws, and sheaths of the anterior limbs, and in general all that is visible of the caterpillar. The new organs appear under the old ones as in a sheath, so that the caterpillar effects the changes by withdrawing itself from the old skin, when it finds itself lodged in too narrow a compass.

But to produce the change, to push off the old covering, and bring forward the new, is a work of labour and time. Those caterpillars who live in society, and have a kind of nest or habitation, retire there to change their skins, fixing the hooks of the feet, during the operation, firmly in the web of their nest. Some of the solitary species spin at this time a slender web, to which they affix themselves. A day or two before the moment approaches, the insect ceases to eat, and loses its usual activity; in proportion as the time of change advances, the colour of the caterpillar becomes more opaque; the skin hardens and withers, and is soon incapable of receiving those juices by which it was heretofore nourished and supported.

supported. The insect may now be seen, at distant intervals, to elevate its back, and stretch itself to its utmost extent; sometimes to lift up the head, move it a little from side to side, and then let it rest again. By repeated exertions, all the vessels which conveyed the nourishment to the exterior skin are disengaged, and cease to act; and a slit is made on the back, generally beginning at the second or third ring; the new skin may now be just perceived, being distinguished by the freshness and brightness of its colour; the caterpillar then presses the body like a wedge into this slit, by which means it is soon opened from the first down to the fourth ring; this renders it large enough to afford the insect a passage, which it soon effects in a very curious manner.

The caterpillar generally fasts a whole day after each moulting, for it is necessary that the parts should acquire a certain degree of consistency, before it can act in its usual manner; many also perish under the operation. The body having grown under the old skin, till the insect was become too large for it, it always appears much larger after it has quitted the exuvia: now as the growth was gradual, and the parts soft, the skin pressed them together, so that they lay in a small space; but, as soon as the skin is cast off, they are as it were liberated from their bounds, and distend themselves considerably. Some caterpillars, in changing their skin, from smooth, become covered with fine hair; while others, that were covered with this fine hair, have the last skin smooth. The silkworm, previous to its chrysalis or pupa state, casts its skin four times; the first is cast on the tenth, eleventh, or twelfth, day, according to the nature of the season; the second, in five or six days after; the third in five or six days more, and the fourth and last in six or seven days after the third.

Entomologists distinguish the different appearances of the insect in its pupa state, as follows: It is called
coarctata,

coarctata, when it is confined to a case of a globular form, without the smallest resemblance to the structure of the insect it contains, as in the diptera. It is called *obtecta*, when the insect is enveloped in a crustaceous covering, consisting of two parts, one of which surrounds the head and thorax, the other the abdomen. It is termed *incomplete*, when the pupa has perceptible wings and feet, but cannot move them, as in most of the hymenoptera. *Semicomplete*, when the pupa can walk or run, having only the rudiments of wings; as in the class hemiptera. The difference between the pupa and the larva of this order, is very inconsiderable; as they eat, walk, and act, just as they did in their primitive state. *Complete* are those which take their perfect form at their birth, and do not pass, like other insects, through a variety of states, though they often change their skin; as is the case with many of the aptera class.

It is a general rule, that all winged insects necessarily pass through the larva and pupa state, before they assume their perfect form: there are also insects which have no wings, and yet undergo similar transformations, as the bed bug, the flea, &c. Other insects, which have no wings, and which always remain without them, never pass through the pupa state, but are subject to considerable changes, as well with respect to the number as the figure of their parts; thus mites have four pair of feet, and two smaller ones at the fore part of the body, near the head; yet some of these are born with only three pair of feet, the fourth is not evolved till some time after their birth. The figure of the *monoculus quadricornis* changes considerably after its birth. The *julus* is an insect with a great number of feet; and yet these at their birth have only three pair, the rest putting not forth till some time after.

When the caterpillar has attained to its full growth and the parts of the future moth or butterfly are sufficiently

ciently formed beneath its skin, it prepares for its change into the pupa state; it seeks for a proper place in which to perform the important business. The different methods employed by these little animals to secure this state of rest, may be reduced to four: some spin follicles or cones, in which they inclose themselves; others conceal themselves in little cells, which they form under ground; some suspend themselves by a glutinous matter at their posterior extremity; while others are suspended by a girdle that goes round their body. Preparatory to the change, the caterpillar empties itself of all the excrementitious matter that is contained in the intestines, voiding at the same time the membrane which served as a lining to these and the stomach. The intestinal canal is composed of two principal tubes, the one inserted into the other; the external tube is compact and fleshy, the internal one is thin and transparent; it is the inner tube, which lines the stomach and intestines, that is voided with the excrement before the metamorphosis. It generally perseveres in a state of rest for several days, which affords the external and internal organs that are under the skin an opportunity of gradually unfolding themselves. In proportion as the change into the pupa form approaches, the body is observed often to extend and contract itself; the hinder part is that which is first disengaged from the caterpillar skin; when this part of the body is free, the animal contracts and draws it up towards the head; it then liberates itself in the same manner from the two succeeding rings, consequently the insect is now lodged in the fore part of its caterpillar covering; the half which is abandoned remains flaccid and empty, while the fore part is swollen and distended. The animal, by strong efforts, still forcing itself against the fore part of the skin, bursts the skull into three pieces, and forms a longitudinal opening in the three first rings of the body; through this it proceeds,

VOL. XIII. No. 165. F drawing

drawing one part after the other, by alternately lengthening and shortening, swelling and contracting, the body and different rings; or else, by pushing back the exuvia, finally gets rid of its reptile form.

The caterpillar, thus stripped from its skin, now becomes the pupa, nymph, chrysalis, or aurelia, in which the parts of the future moth are inclosed; but are so soft, that the slightest touch will discompose them. The exterior part of the chrysalis is at first exceedingly tender, soft, and partly transparent, being covered with a viscous fluid; this soon dries up, thickens, and forms a crust round the animal, capable of resisting external injuries; a case, which is at the same time the sepulchre of the caterpillar, and the cradle of the moth; where, as under a veil, this curious transformation is carried on. The pupa was first called a *chrysalis*, or "creature made of gold," from the resplendent yellow colour with which some kinds are adorned. Réaumur has shewn us whence they derive this rich colour; that it proceeds from two skins, the upper one a beautiful brown, which lies upon or covers a highly polished and smooth white skin; the light reflected from the last, in passing through, gives it the golden yellow, in the same manner as this colour is often given to leather; so that the whole appears gilt, although no gold enters into the tincture. The chrysalis of the common white butterfly furnishes a most beautiful object for the lucernal opake microscope.

Those who are desirous to discover distinctly the various members of the moth in the pupa, should examine it before the fore-mentioned fluid is dried up, when it will be found to be only the moth with the members glued together; these, by degrees, acquire sufficient force to break their covering, and disengage themselves from the bands which confine them. While in this state, all the parts of the moth may be traced out, though so folded and laid together,

ther, that it cannot make any use of them; nor is it expedient that it should, as they are too soft and tender to be used, and pass through this state merely to be hardened and strengthened. To examine the moth concealed under the skin of a caterpillar, one of them should be taken at the last change; when the skin begins to open, it should be drowned in the spirit of wine, or brandy, and be left therein for some days to harden; the skin of the caterpillar may then be easily removed: the rudiments of the chrysalis will be first discovered, after which the tender moth appears; and its wings, legs, antennæ, &c. may be opened and displayed by a careful operator.

The time which the moth or butterfly remains in the pupa state is not always the same, varying in different species, and depending also upon the warmth of the weather, and other adventitious circumstances; some remain in that situation for a few weeks; others do not attain their perfect form for eight, nine, or eleven, months: this often depends on the season in which they assume the pupa form, or rather on the time of their birth. Some irregularities are also occasioned by the different temperature of the air, by which they are retarded or accelerated, so as to be brought forward in the season best suited to their nature and the ends of their existence.

When the moth or butterfly is sufficiently matured to break the bonds which surround it, and of which it seems to be informed by its internal sensations, it makes a powerful effort to escape from its prison, and view the world with new-formed eyes. A small degree of motion, or a little inflation of the body, is sufficient to enlarge the hole, and afford the animal room to escape from its confinement. When the moth first sees the day, it is humid and moist; but this humidity soon evaporates, the interior parts dry and harden as well as the exterior; the wings, which are wrinkled, being thick and small, then extend themselves,

themselves, and the fibres, which were at first flexible, become hard and stiff. The wings, though at first scarcely half the length of the body, soon acquire their full size: nor is it the wings only which are thus rapidly increased; all their spots and colours are proportionably extended, so that what at first appeared as so many confused points, become distinct and beautiful ornaments; and those that are furnished with a tongue or trunk, curl and coil it up. When the wings are unfolded, the tongue rolled up, the parts sufficiently dried, and the different members strengthened, it takes its flight. Most of them, soon after they have attained their perfect state, void an excrementitious substance; and Reaumur thinks that they eject very little, if any, during the rest of their lives.

If the moth be now opened down the belly, the gross artery, which is called the heart, will be visible, and the contractions and dilatations, by which it pushes forward the liquor it contains, may be easily observed. One of the most remarkable circumstances is, that the circulation of this fluid in the winged state is directly contrary to that which took place in the caterpillar; in this, the liquor moved from the tail to the head, whereas in the winged state, it moves from the head to the tail; so that the fluid which answers the purposes of blood, goes from the superior towards the inferior parts; but in the caterpillar the order is reversed: it proceeds from the inferior towards the superior parts.

The industry of those moths that spin cones or follicles in which they inclose themselves for their transformation, is well known and admired; since it is from a species of these, the *Phalæna mori*, or silk-worm, that we derive so many benefits to the community. All caterpillars undergo similar changes with it, and many of the genus greatly exceed it in beauty: but the golden tissue in which the silk-worm wraps

wraps itself, far surpasses the filky threads of all the other species: they may indeed come forth with a variety of colours, and wings bedecked with gold and scarlet; yet they are but the beings of a summer's day; both their life and beauty quickly vanish, and leave no remembrance of them; but the silk-worm leaves behind it such beneficial monuments, as at once record the wisdom of its Creator, and his bounty to man. The substance of which the silk is formed, is a fine yellow transparent gum, contained in two reservoirs that wind about the intestines, and which, when they are unfolded, are about ten inches long; they terminate in two exceeding small orifices near the mouth, through which the silk is drawn, or spun to the degree of fineness which its occasions may require.

When the silk-worm, or caterpillar of the *Phalæna mori*, is about to enter its pupa state, it sets to work, first spinning some random threads, which serve to support the future superstructure; upon these it forms an oval of a loose texture, consisting of what is called the floss-silk; within this it forms a more consistent ball of silk, remaining during the whole business within the circumference of the spheroid that it is forming, resting on its hinder parts, and with its mouth and fore legs directing and securing the threads. These threads, when measured, have been found to be about three hundred yards long, and so fine, that eight or ten are generally rolled off into one by the manufacturers. The silk-worm usually employs about three days in finishing this cone; the inside is generally smeared with a kind of gum, that is designed to keep out the rain: within this cone it assumes the pupa form, and remains therein from fifteen to thirty days, according to the warmth of the climate. When the moth is sufficiently matured, it moistens the end of this cone, and by frequent motions of the head loosens the texture of the silk, so

as to form a hole without breaking it, and through which it escapes.

The coleoptera genus, or beetle, is an insect also disengaged from the pupa form, before it can attain its winged state. The pupa is a transformation in like manner from the worm or larva, and this derived its existence from the egg; so that here, as in the foregoing instances, one insect is exhibited in four different forms, before it acquires its perfect organization, or mature state of life. The worm or grub of the beetle, like other insects in the larva state, in order to undergo its transformation, discharges all its excrement, and forms a convenient hole in the earth; where it casts not off merely the external covering, but the throat, a part of the stomach, and the inward surface of the great canal, change at the same time their skin. After the transformation, the head and teeth are white and tender, though before as hard as bone; so that the larva, when provoked, will attempt to gnaw iron. When the worm assumes the pupa state, it forms with the hinder feet a polished cavity; in this it lies for some time immoveable; after which, by voiding an excrementitious substance, and by the evaporation of humidity, it becomes thinner and shorter, the skin more furrowed and wrinkled, so that it soon appears as if it were starved by degrees. If it be dissected about this period, the head, the head, the belly, and the thorax, may be clearly distinguished. While some external and internal parts are changing by a slow accretion, others are gently distended by the force of the impelled humours. The body contracting itself, while the circulating fluid is propelled towards the head, forces the skull open in three parts, and the skin in the middle of the back is separated by means of an undulating motion of the incisions of the back; at the same time the eyes, the horns, the lips, &c. cast their exuvia. During this operation, a thin watery humour is diffused between the

the old and new skin, which renders the separation easier. The process going on gradually, the larva is at last disengaged from its skin, and the limbs and parts are, by a continual unfolding, transformed into the pupa state; after which, it twists and compresses the exuvia by the fundament, and throws it towards the hinder part under the belly. The pupa is at this time very delicate, tender, and flexible; and affords a most pleasing appearance to an attentive observer. In it the future parts of the beetle are finely exhibited, so disposed and formed, as soon to be able to serve the creature in a more perfect state of life, and to put on a more elegant form.

The pupa of this insect weighs, a little after its change, much heavier than it does in its beetle state; this is also the case with the pupa of the bee and hornet. The latter has been found to weigh ten times as much as the hornet itself; this is probably occasioned by a superabundant moisture, by which these insects are maintained and nourished during their torpid state. How long the scene of mutation continues is not known; some remain during the whole winter, more particularly those which quit the larva state in autumn, when a sudden cold checks their further operations, and consequently they remain a pupa for several months. Some species of the beetle tribe go through all the stages of their existence in a season, while others employ near four years in the process, and live as winged insects a year.

When the proper time for the final change arrives, all the muscular parts grow strong, and are thus more able to shake off their last integuments, which is performed exactly in the same manner as in the passage of the insect from the larva to the pupa state; so that in this last skin, which is extremely delicate, the traces of the pulmonary tubes, that have been pulled off and turned out, again become visible. All parts of the insect, and more particularly the wings and
their

their cases, are at this period swelled and extended by the air and fluids which are driven into them through the arteries and pulmonary tubes; the wings are now soft as wet paper, and the circulating fluid issues from them on the least wound; but when they have acquired their proper consistency, which in the elytra is very considerable, they do not exhibit the least sign of any fluid within them, though cut or torn almost asunder. The pupa being disengaged from its skin, assumes the form of a beetle, and acquires a distinction of sex, being either male or female. The insect now enters on its last state of existence—raises itself towards the skies, plays in the sun-beam, propagates its like, deposits the eggs for a new progeny in a secure place—and dies.

Such is the process of the transformation of those insects whose habits confine them to dry land. We shall now describe the metamorphosis of an aquatic insect, the *musca chamaeleon*. In the worm or larva condition it lives in the water, breathes by the tail, and carries its legs within a little trunk near its mouth. When the time arrives for its pupa state, it goes through the change without casting off the skin of the larva. But in the imago or fly state, it would infallibly perish in the water, were not the larva by nature instructed how to choose a suitable situation for its approaching transformation. The larva of this insect appears to consist of twelve annular divisions; by these it is separated into a head, thorax, and abdomen; but as the stomach and intestines lie equally in the thorax and abdomen, it is not easy to distinguish their limits until the insect approaches the pupa state. The parts most worthy of notice, are the tail, and the snout or trunk.—The tail is furnished with an elegant circle of bristles, disposed quite round it in annular form; by means of this the tail is supported on the surface of the water, while the worm or larva is moving therein, the body

in

in the mean while hanging towards the bottom in search of food. When it is disposed to sink to the bottom, it turns the bristles of the tail towards each other, hollow in the middle, but close towards the extremity; by these means a conical space is formed, and the bladder of air pent up in it looks like a pearl. It is by the assistance of this little balloon, that the insect raises itself again to the surface. If this bubble escape, it can replace it from the pulmonary tubes; sometimes large quantities of air may be seen to arise in bubbles from the tail of the worm to the surface of the water, and there mix with the incumbent atmosphere. This operation may be easily seen by placing the worm in a tumbler of water, where it will afford a very entertaining spectacle. The snout or trunk is divided into three parts, of which that in the middle is immoveable; the two other parts grow from the sides of the former; these are moveable, vibrating in a very singular manner, like the tongues of lizards and serpents. The greatest strength of the animal resides in these lateral parts of the snout; it is on these that it walks at the bottom of the water, and also on dry land; appearing, as it were, to walk on its mouth, and using it as a parrot does its beak, to climb with greater advantage.

These larvæ are generally to be found in shallow standing waters, about the beginning of June, sooner or later as the summer is more or less favourable. After a certain period they pass into the pupa form. When they are about to change, they betake themselves to the herbs that float on the surface of the water, and creep gently thereon, till at length they lie partly on the dry surface, and partly on the water; when in the larva or pupa state, they can live in water, but can by no means inhabit there when changed into flies. When these worms have found a proper situation, they by degrees contract themselves, and lose all power of motion. The inward

parts of the worm's tail now separate from the outer skin, and become greatly contracted; by this contraction, an empty space is left, into which the air soon penetrates. Thus this insect passes into the pupa state under its own skin, entirely different from that of the caterpillar. This change may often be observed to take place in the space of ten or twelve hours; but in what manner it is performed, or how effected, is hidden from our view.

Whilst the larva is thus changing under the skin, the body, the head, and tail, separate insensibly from their outward vesture. The legs at this time, and their cartilaginous bones, are, on account of the parts which are withdrawn from them, left empty; the worm loses also the former skull, together with the bones belonging thereto, which remain in the skin of the exuvia. It is worthy of notice, that the optic nerves separate also from the eyes, and no more perform their office. The muscles of the rings in like manner, and a great part of the pulmonary points of respiration, are separated from the external cuticle. Thus the whole body contracts itself by degrees into a compact mass. At this time the gullet and pulmonary tubes cast a coat within the skin. To make this evident, it is necessary to open the abdomen; when the pupa, its parts, together with the cast-off pulmonary pipes, may be clearly distinguished.

When the time approaches that the hidden insect is to attain the imago or fly state, which generally happens in about eleven days after the preceding change, the superfluous humours are evaporated, and the pupa is contracted into the fifth ring of the skin, and the four last rings of the abdomen are filled with air, through the aperture in the respiratory orifice of the tail. This may be seen by exposing the pupa for a short space to the rays of the sun, and then putting its tail in water, when it will breathe stronger than it did before, and, by expressing an air bubble out of its tail,

tail, and then sucking it in again, will manifestly perform the action of inspiration and expiration. If the exterior case be opened near this period, a wonderful variety of colours may be perceived through the skin which invests the pupa. The colours of many of the different parts are now changed; some parts from aqueous become membranaceous, some fleshy, and others crustaceous. When the fly begins to appear, the exterior skin is seen to move about the third and fourth anterior ring; the insect then uses all its efforts to quit the interior and exterior skin at one and the same time. The exterior skin is divided into four parts; the insect immediately afterwards breaks open its inner coat, and, casting it off, escapes from its prison in the form of a beautiful fly. Having thus acquired its perfect state, the little animal, which lived before in water and mud, enters into a new scene of life, visits the fields and meadows, is transported through the air on its elegant wings, and sports in the wide expanse with unrestrained freedom. For a view of this insect in the worm state, see the Entomology Plate II. fig. 14.

Another very curious aquatic insect is the *libellula*, or dragon-fly. This insect partakes of almost all colours, green, blue, crimson, scarlet, and white; some unite a variety of the most vivid tints, and exhibit in one animal more different shades than are to be found in the rainbow. But it is not to colour alone that their beauty is confined, it is heightened by the brilliancy of their eyes, and the delicate texture and wide expansion of their wings. The larva of the *libellula* is an inhabitant of the water, the fly itself is generally found hovering on its banks. The dragon-fly is exhibited in the Entomology Plate I. fig. 10, 11; and the larva and pupa in Plate II. fig. 15, 16.

These insects are produced from an egg, which is deposited in the water by the parent; the egg sinks to the bottom, and remains there till the worm finds

strength to break the shell. The larva is hexapode, and not so long as the fly; on the trunk are four prominences or little bunches, which become more apparent as the larva increases in size, and changes its skin. These bunches contain the rudiments of the wings, which adorn the insect when in its perfect state. The head of the larva is exceedingly singular, the whole fore part of it being covered with a mask, having proper cavities to suit the different prominences of the face; it is of a triangular form, growing smaller towards the bottom; at this part there is a knuckle that fits a cavity near the neck, on which it turns as on a pivot. The upper part of this mask is divided into two pieces or shutters, which the insect can open or close at pleasure; it can also let down the whole mask whenever it pleases. The edges of the shutters are jagged like a saw. It makes use of the mask to seize and hold its prey. These larva generally live and feed at the bottom of the water, swimming only occasionally: their manner of moving in the water is curious, being by sudden jerks; but this motion is not occasioned by their legs, which at this time are kept close to the body; it is by forcing out a stream of water from the tail, that the body is carried forward; this may be easily perceived, by placing them in a flat vessel, in which there is only just water enough to cover the bottom. Here the action of the water squirted from the tail will be very visible; it will occasion a small current, and give a sensible motion to any light bodies on the surface. This action can only be effected at intervals, because after each expulsion the insect is obliged to inhale a fresh supply of water. The larva will sometimes turn its tail above the surface of the water, and eject a small stream from it as from a little fountain, and that with considerable force.

The pupa differs but little from the larva; the bunches containing the wings grow large, and begin

to appear like four short thick wings. It is full as lively as the larva, seeking and enjoying its food in the same manner. When arrived at its full growth, and ready to go through its last change, it approaches the edge of the water, and fixes itself firmly to a piece of wood or other substance by its claws. It remains for some time immoveable; the skin then opens down the back, and on the head; through this opening is exhibited the real head and eyes, and at length the legs; it then creeps gradually forward, drawing first its wings, and then the body, out of the skin. The wings, which are moist and folded, soon expand themselves to their real size; the body is also extended till it has gained its proper length, which extension is accomplished by the propelling force of the circulating fluids. When the wings and limbs have acquired sufficient strength, it enters on a more noble state of life: in this new scene it enjoys the living fragrance of the richest meadows, revels in delight, and, having laid the foundation for its future progeny, sinks into an easy dissolution. In its mature state the dragon-fly is of a ferocious disposition, hovering in the air like a bird of prey, in order to feed on and destroy every species of fly; its appetite is gross and voracious, not confining itself to small flies only, but the large flesh-fly, moths, and butterflies, are equally subjected to its tyranny.

The female of the *cynips*, or gall-insect, which has no wings, passes through no transformation; while the male, which has four wings, passes through the pupa-state in order to become a fly. The principal habitude of the female is this: that, after the impregnation by the male, and with a view to the preservation of a future progeny, she fixes herself to the branch or leaf of a tree, where she makes a puncture, which, from the gelatinous matter thrown out by the insect, added to the sap of the vegetable, increases in size, and becomes a true gall; here the female deposits an egg,

egg, for which the gall first serves as a nidus, and afterwards as an habitation for the larva.

The *aphides*, or plant-lice, to arrive at their respective state, pass through that of the semi-complete pupa, and their wings do not appear till they have quitted their pupa state; but, as in all the families of the pucerons there are many which never become winged, we must not forget that these undergo no transformation, remaining always the same, without changing their figure, though they increase in size and change their skin.

An insect that must cast off its exuvia, or moult five times before it attains the pupa state, as is the case with many of the caterpillars, may be considered as composed of five organized bodies inclosed within each other, and nourished by common viscera placed in the centre: what the bud of the tree is to the invisible buds it contains, such is the exterior part of the caterpillar to the interior bodies it conceals in its bosom. Four of these bodies have the same essential structure, namely, that which is peculiar to the insect in its larva or caterpillar state: the fifth body is that of the pupa. The respective state of these bodies is in proportion to their distance from the centre of the animal; those that are farthest off have most consistence, or unfold themselves soonest. When the exterior body has attained its full growth, that interior one which is next in order is considerably unfolded; it is then lodged in too narrow a compass, therefore it stretches on all sides the sheath which covers it; the vessels which nourish the external covering, are broken by this violent distension, and ceasing to act, the skin wrinkles and dries up; at length it opens, and the insect comes forth with a new skin, and new organs. When we have thus formed the idea that all the exterior parts are inlaid, or included one within the other, the production of new organs does not appear so embarrassing, being nothing more than

than a simple developement; but it is more difficult to form any conception of the changes that happen in the viscera before and after the transformation, the various modifications they undergo eluding our researches. We have already observed, that a little before the change the caterpillar rejects the membrane that lines the intestinal bag: this bowel has hitherto digested only gross food, whereas it must hereafter digest that which is very delicate: a fluid that circulates in the caterpillar from the hind part towards the head, circulates a contrary way after transformation. Now if this inversion is as real as observation seems to indicate, how amazing the change the interior parts of the animal must have undergone!

To give the curious reader a competent idea of the admirable structure of the muscles and interior mechanism of the caterpillar, we have, in the Entomology Plate II. fig. 1, exhibited an anatomical section of the caterpillar of the *Phalæna cossus*, or goat-moth, considerably magnified to shew out its parts. The body of this caterpillar, and of insects in general, includes four principal viscera; the spinal marrow, the intestinal bag, the heart, and tracheal vessels. The spinal marrow, or principal trunk of the nerves of insects, is a whitish thread, extended the whole length from the head to the hindmost part, furnished at intervals with small knots or ganglions. From these knots proceed the nervous threads that are supposed to be the instruments of sensation and motion. On the medullary thread is placed the intestinal bag, which is equal to it in length; it is a long gut, in which are contained the œsophagus, the stomach, and intestines. Down the back, and parallel to the intestinal bag, runs a long thin vessel, in which may be perceived through the skin of the insect alternate contractions and dilatations; this part is supposed to perform the functions of the heart. The tracheal vessels of insects are very similar to those of plants;

plants; are of the same structure, colour, and elasticity, and are, like them, dispersed through the whole body.

The internal structure of the caterpillar, as represented in the plate, divides itself into twelve parts, corresponding to its twelve rings. Each of these rings is distinguished from that which follows, and that preceding it, by a kind of neck, or small hollow part or section. By conceiving a line to pass through these necks, and forming boundaries to the rings, the divisions become more apparent. The anatomical delineation of the muscles of the head; the two palpi; the truncated muscles of the lower lip, and part of those which give it motion; the two ganglions of the neck united; the two silk vessels which form tubes from the right and left, and pass through the centre of the head; the œsophagus; the two dissolving vessels; the cephalic arteries, the ten abductor muscles of the jaw; the four occipital muscles; also a nerve of the first pair, belonging to the ganglion of the neck, may be easily traced by contemplating the same plate.

The muscles of the body of insects have neither the exterior form, nor the colour, of those of larger animals. In their natural state they are soft, and have the appearance of a jelly; they are of a greyish blue, and the silver-coloured appearance of the pulmonary vessels, which creep over and penetrate their substance, exhibits under the microscope a most beautiful spectacle. When the caterpillar has been soaked for some time in spirit of wine, they lose their elasticity and transparency, and become firm, opaque, and white; the aerial vessels disappear. At first sight they might be taken for tendons, as they are of the same colour, and possess almost the same lustre. They are generally flat, and of an equal size throughout; the middle seldom differs either in colour, substance, or size, from the extremities. The ends are fixed to

the

the skin; the rest of the muscle is generally free and floating; several of them branch out considerably; the branches extend sometimes so far, that it is not always easy to discover whether they are distinct and separate muscles, or parts of another. They are of a moderate strength; those that have been soaked in spirit of wine, when examined by the microscope, will be found to be covered with a membrane which may be separated from them; they then appear to consist of several parallel bands, disposed according to the length of the muscle. These, when divided by the assistance of very fine needles, appear to be composed of still smaller bundles of fibres, in the same direction; which, when examined by a very deep magnifier, and in a favourable light, appear twisted like a small cord. If the muscles are separated by means of very fine needles, in a drop of some fluid, we find that they are not only composed of fibres, membranes, and aerial vessels, but also of nerves; and, from the drops of oil that may be seen floating on the fluid, that they are also furnished with many unctuous particles. The muscles in the caterpillar are very numerous, exceeding by much those of the human body. They occupy the greatest part of the head; there is an amazing number at the oesophagus, the intestines, &c. the skin is as it were lined by different beds of them, placed one over the other, and ranged with wonderful symmetry. The number of muscles is truly astonishing; there are 228 in the head, 1647 in the body, and 2066 in the intestinal tube, making in all 3941!

The spinal marrow and the brain of the caterpillar, seem to have very little relation to those of man. We find in the head of that which we are describing, a part which seems to answer the purpose of the brain, because the nerves that are disseminated through the head are derived from it; but then this part is unprotected, and so small, that it does not occupy one-

fifth part of the head; the surface is smooth, and has neither lobes nor anfractuosity; and if we call this a brain, the caterpillar may be said to have thirteen, as there are twelve more such parts following each other in a line; they are nearly of the same size with that in the head, and of the same substance; and it is from them that the nerves are distributed through the whole body. Lest the idea of thirteen brains, might appear absurd, M. Lyonet has called these parts ganglions. The spinal marrow in the human species descends down the back, inclosed in a bony case; is large with respect to its length, and not divided into branches, diminishing in thickness in proportion as it is removed further from the brain. In the caterpillar, the spinal marrow goes along the belly, is not inclosed in any tube, is very small, forks out at intervals, and is nearly of the same thickness throughout, except at the ganglions. The substance of the spinal marrow, and of the ganglions, is not near so tender and easily separated as in man; it has a very great degree of tenacity, and does not break without considerable tension. The substance of the ganglions differs from that of the spinal marrow, as no vessels can be discovered in the latter, whereas the former are full of very delicate ones. The skilful anatomist of the caterpillar has counted forty-five pair of nerves, and two single ones; so that there are ninety-two principal nerves, whose ramifications are innumerable.

The tracheal arteries of the caterpillar are two large elastic vessels, which, with their numerous ramifications, may be pressed close together, and drawn out considerably, but return immediately to their usual size when the tension ceases; they creep under the skin close to the spiracula, one at the right side of the insect, the other at the left, each of them communicating with the atmosphere, by means of nine spiracula; they are nearly as long as the body, beginning

at the first spiraculum, and going a little farther than the last, terminating in some branches which extend to the extremities of the body. Round about each spiraculum the tracheal artery pushes forth a great number of branches, which are again divided into smaller ones; these further subdivide, and spread through the whole body of the caterpillar. This vessel and its principal branches are composed of three coats, which may be separated one from the other. The exterior covering is a thick membrane, furnished with a great number of fibres, which describe a vast variety of circles round it, communicating with each other by numerous shoots. The second is very thin, and transparent; no particular vessel is distinguished in it. The third is composed of scaly threads, which are generally turned in a spiral form, and come so near each other, as scarcely to leave any interval; these threads are curiously united with the membrane which occupies the intervals, and form a tube which is always open, notwithstanding the flexure of the vessel. The principal tracheal vessels branch out into 236 smaller ones, from which there spring 1326 different ramifications.

The part of the caterpillar which naturalists call the heart, is of a nature very different from that of larger animals. It is almost as long as the caterpillar itself, lies immediately under the skin at the top of the back, entering into the head, and terminating near the mouth. It is large and spacious towards the last rings of the body, and diminishes very much as it approaches the head, from the fourth to the twelfth division; it has on both sides, at each division, an appendage, which partly covers the muscles of the back; but, growing narrower as it approaches the lateral line, forms a number of irregular lozenge-shaped bodies. This muscular tube has been deemed the heart of the caterpillar; first, because it is generally filled with a kind of lymph, which has been supposed

fifth part of the head; the surface is smooth, and has neither lobes nor anfractuosity; and if we call this a brain, the caterpillar may be said to have thirteen, as there are twelve more such parts following each other in a line; they are nearly of the same size with that in the head, and of the same substance; and it is from them that the nerves are distributed through the whole body. Lest the idea of thirteen brains, might appear absurd, M. Lyonet has called these parts ganglions. The spinal marrow in the human species descends down the back, inclosed in a bony case; is large with respect to its length, and not divided into branches, diminishing in thickness in proportion as it is removed further from the brain. In the caterpillar, the spinal marrow goes along the belly, is not inclosed in any tube, is very small, forks out at intervals, and is nearly of the same thickness throughout, except at the ganglions. The substance of the spinal marrow, and of the ganglions, is not near so tender and easily separated as in man; it has a very great degree of tenacity, and does not break without considerable tension. The substance of the ganglions differs from that of the spinal marrow, as no vessels can be discovered in the latter, whereas the former are full of very delicate ones. The skilful anatomist of the caterpillar has counted forty-five pair of nerves, and two single ones; so that there are ninety-two principal nerves, whose ramifications are innumerable.

The tracheal arteries of the caterpillar are two large elastic vessels, which, with their numerous ramifications, may be pressed close together, and drawn out considerably, but return immediately to their usual size when the tension ceases; they creep under the skin close to the spiracula, one at the right side of the insect, the other at the left, each of them communicating with the atmosphere, by means of nine spiracula; they are nearly as long as the body, beginning

at the head, and ending at the tail.

at the first spiraculum, and going a little farther than the last, terminating in some branches which extend to the extremities of the body. Round about each spiraculum the tracheal artery pulshes forth a great number of branches, which are again divided into smaller ones; these further subdivide, and spread through the whole body of the caterpillar. This vessel and its principal branches are composed of three coats, which may be separated one from the other. The exterior covering is a thick membrane, furnished with a great number of fibres, which describe a vast variety of circles round it, communicating with each other by numerous shoots. The second is very thin, and transparent; no particular vessel is distinguished in it. The third is composed of scaly threads, which are generally turned in a spiral form, and come so near each other, as scarcely to leave any interval; these threads are curiously united with the membrane which occupies the intervals, and form a tube which is always open, notwithstanding the flexure of the vessel. The principal tracheal vessels branch out into 236 smaller ones, from which there spring 1326 different ramifications.

The part of the caterpillar which naturalists call the heart, is of a nature very different from that of larger animals. It is almost as long as the caterpillar itself, lies immediately under the skin at the top of the back, entering into the head, and terminating near the mouth. It is large and spacious towards the last rings of the body, and diminishes very much as it approaches the head, from the fourth to the twelfth division; it has on both sides, at each division, an appendage, which partly covers the muscles of the back; but, growing narrower as it approaches the lateral line, forms a number of irregular lozenge-shaped bodies. This muscular tube has been deemed the heart of the caterpillar; first, because it is generally filled with a kind of lymph, which has been supposed

to be analagous to the blood of larger animals; secondly, because in all caterpillars, whose skin is in some degree transparent, continual, regular, and alternate, dilatations and contractions may be perceived along the superior line, beginning at the eleventh ring, and going on from ring to ring to the fourth, whence this vessel has been considered as a file of hearts; but still this viscera seems to have very little relation to the heart of larger animals; we find no vessel opening into it to answer the aorta, vena cava, &c. Yet it cannot be of any importance in what manner this organ be formed, any more than that of the brain, so that the Great Author of its structure has enabled it to perform its proper office. Near the eighth division are two white oblong masses, that join the tube of the heart; they have been called reniform bodies, because they are something similar to a kidney in their shape.

The *corpus crassum* is, with respect to volume, the most considerable part of the whole caterpillar; it is the first and only substance that is seen on opening it, forming a kind of sheath, which envelopes and covers all the entrails, and introducing itself into the head, enters all the muscles of the body, filling the greatest part of the empty spaces in the caterpillar. It is of a milk-white colour. In its configuration it is very similar to the human brain. When the different masses of the *corpus crassum* which covers the entrails are removed, the largest parts are the œsophagus, the ventricle, and the large intestines. The *œsophagus* descends from the bottom of the mouth to about the fourth division. The anterior part, which is in the head, is fleshy, narrow, and fixed by different muscles to the crustaceous parts thereof; the lower part which passes into the body is wider, and forms a kind of membranaceous bag, which is covered with very small muscles; near the stomach it is again narrower, and is as it were bridled by a strong nerve, which is
fixed

fixed to it at distant intervals. The *ventricle* begins a little above the fourth division, where the *œsophagus* finishes, and terminates at the tenth division; it is about seven times longer than it is broad; the anterior part, which is the broadest, is generally folded. The folds diminish with the bulk, in proportion as it approaches the intestines. An assemblage of nerves cover the surface; it is surrounded by a number of aerial vessels, and opens into a tube, which M. Lyonet calls the large intestine.

There are three of these large tubes or intestines, each of which differs from the other so much, both in structure and character, that they should have a particular name to distinguish them. As most caterpillars are endued with a power or faculty of spinning, they are provided with two vessels where the substance is prepared, which, when drawn out, and extended in the air, becomes a silken thread; these two vessels are termed the silk-vessels or tubes; in the caterpillar of the *coffus* they are often above three inches long, and are distinguished into three parts, the anterior, the intermediate, and posterior. It has also two other vessels, which are supposed to prepare and contain the liquor by which it dissolves the wood on which it feeds. Such is the wonderful organization of this apparently trifling and imperfect animal. Yet the four-thousand muscles employed in the construction of the caterpillar of the *coffus*, cannot be considered without the deepest astonishment: their admirable co-ordination and junction with other parts equally numerous, yet all harmonizing and acting together as if they were essentially one, naturally lead the mind to consider the nature and perfection of creation, and to perceive that it is an exhibition of the highest wisdom and most profound omnipotence.—See Lyonet sur la Chenille de Saule; and Théologie des Insectes. Also Mr. Adams on the Microscope, by Kanmacher,

One of the greatest mysteries appertaining to the insect tribes, is their mode of *generation*. Many ancient philosophers imagined that insects were produced from corrupt and putrefied substances, and thus owed their origin to mere chance. But they should have taught that every degree of life must proceed from the fountain and source of all life; and that therefore insects must conform to that general law which runs through the whole of animated nature, namely, that the conjunction of the male and female is necessary for the production and propagation of their offspring.

But though insects are, like larger animals, for this end distinguished into male and female, yet in some classes there appears to be a kind of mules, partaking of neither sex, though themselves originating from the conjunction of both; and many other particularities, relative to the sexes of insects, seem equally mysterious and unaccountable: though it is most consonant to reason that all such insects as are termed mules, neuters, or which appear of doubtful or imperfect conformation, are only such whose parts are not yet completely evolved, and consequently not arrived at their last or perfect state. It is evident that this is the case with what are called *labourers* among the white ants.

In many insects the male and female are with difficulty distinguished; and in some they differ so widely, that an unskillful person might easily take the male and female of the same insect for different species; as for instance, in the *Phalæna humuli*, *pinariis*, *russula*, &c. The dissimilarity is still greater in those insects in which the male has wings and the female none, as in the *coccus lampyris*, *termes fatale*, *phalæna antiqua*, and the gall-insect, spoken of in p. 53. The female of the *gryllus pedestris* is quite destitute of wings, and passed for a *gryllus* in its larva state, until it was seen in copulation, which proved its maturity;

turity; for it is an established fact, that no insect can propagate till it arrives at its last or perfect state.

—*Pleraque insectorum genitalia sua intra anum habent abscondita, et penes solitarios, sed nonnulla penem habent bifidum: cancri autem et aranei geminos, quemadmodum nonnulla amphibia, et quod mirandum in loco alieno, ut cancer, sub basi caudæ. Araneus mas palpos habet clavatos, qui penes sunt, juxta os utrinque unicum, quæ clavæ sexum nec speciem distinguunt; et fœmina vulvas suas habet in abdomine juxta pectus; heic vero si unquam vere dixeris: res plena timoris amor, si enim prout inauspicato accesserit fœmina ipsum devorat, quod etiam fit, si non statim se retraxerit. Libellula fœmina genitale suum sub apice gerit caudæ, et mas sub pectore, adeo ut cum mas collum fœmina forcipe caudæ arripit, illa caudam suam pectori ejus applicet, sicque peculiari ratione connexæ volitent.*

Insects are either oviparous or viviparous; in other words, the species is perpetuated either by their laying of eggs, or bringing forth their young alive. The former is the more general case; there are but few instances of the latter. Those insects which pass through the different transformations already described, cannot propagate, therefore, till they arrive at their winged state; and we believe there is seldom any conjunction of the sexes in other classes till they have moulted, or put off their last skin, the cancri and monoculi excepted. Reaumur, tom. iv. p. 415, mentions several species of two-winged flies that are viviparous, bringing forth worms, which are afterwards transformed into flies. The womb of one of these is singularly curious; it is formed of a band rolled up in a spiral form, and about two inches and a half in length; so that it is seven or eight times longer than the body of the fly, and composed of worms placed one on the side of the other with wonderful art; and are many thousands in number.

Among

Among the *aphides*, or pucerons, many bring forth their young alive in summer, but in autumn they deposit eggs upon the branches and bark of trees. The generative habitudes of this genus are very singular: an aphid or puceron, hatched from a rose-leaf, and brought up in the most perfect solitude from the very moment of its birth, in a few days will be found the parent of a numerous family; repeat the experiment on one of the individuals of this new family, and the second generation will multiply like its parent; and this is found to be the case for ten generations, when impregnation by the male appears again necessary for another ten years procreation.

However singular the generation and production of the aphides may appear, that of bees is not less so.—This little republic has at all times gained universal esteem and admiration; and, though they have attracted the attention of the most ingenious inquirers into nature, yet the mode of propagating their species for a long time baffled the ingenuity of ages, and rendered their attempts to discover it abortive. Reaumur was the first who removed the veil, and explained their manner of generating: he discovered that the queen-bee was the only female belonging to a swarm or hive, and the mother of the next generation; that the drones are the males by which she is fecundated, and that the working bees, or those that collect wax on the flowers, that knead it, and form from it the combs and cells, which they afterwards fill with honey, are at the time of neither sex, but *neuters*; and that the neuters afterwards become perfect. The queen-bee is distinguished by her size, being larger than the working-bee or the drone.

Divine Providence instructs the insects in a most remarkable manner to deposit their eggs, not only in safety from their numerous enemies, but also in situations where a sufficient quantity of food is on the spot to support and nourish the larva immediately on
breaking

breaking the shell. The gnat, the ephemera, the phryganea, the libellula, hover over the water all day to drop their eggs, which are hatched in the water, and continue there all the time they are in the larva form. The mass formed by the gnat resembles a little vessel set afloat by the insect; each egg is in the form of a keel, and curiously connected together. The gnat lays but one egg at a time, which she deposits on the water in a very ingenious and simple manner; she stretches her legs out, and crosses them, thus forming an angle to receive and hold the first egg; a second egg is soon placed next the first; then a third, and so on, till the base is capable of supporting itself; these, as they come to maturity, sink deeper. The spawn of this insect is sometimes above an inch long, and one-eighth of an inch in diameter, and tied by a little stem or stalk to some stick or stone. Sometimes they are laid in a single, sometimes in a double, spiral line; sometimes transversely. Many of the moths cover their offspring with a thick bed of hair, which they gather from their own body; while others cover them with a glutinous composition, which, when hard, protects them from moisture, rain, and cold. The gall flies, it has been observed, know how to open the nerves of the leaves, to deposit their eggs in a place which afterwards serves them for a lodging and a magazine of food. The solitary bees and wasps prepare a habitation for their little ones in the earth, placing there a proper quantity of food for them, when they proceed from the egg. The voracious spider is careful of its eggs; the wolf spider carries them on its back in a little bag formed of its silk; it cannot be separated from them but by violence, and exhibits the most marked signs of uneasiness when deprived of them: a circumstance the more remarkable, as they love to destroy each other, and even carry on their courtships with a diffidence and caution unknown in any other species of animals.

The paternal affection and care of the ants is well known. They are not satisfied with placing their eggs in situations made on purpose, and to raise or rear them till they come to the nymph or pupa state, but they even extend their care to the pupæ themselves, removing them from their nest to the surface of the earth, whenever the weather is fine, that they may receive the benignant influence of the sun, carrying them back again as soon as the air begins to grow cold. If any accident disturb their nest, and disperse the pupæ, they manifest the greatest signs of distress, seeking those which are lost and scattered, placing them in some sheltered place while they repair the nest, when they again transport them to it.

The fecundity of insects exceeds in an astonishing degree that of all the productions of nature. Reaumur calculated the fecundity of the queen-bee as follows: he found that she laid in the two months of March and April 12,000 eggs, so that the swarm which left the hive in May consisted of near 12,000 bees, all produced from one mother: but this calculation falls short of that which was made by Leeuwenhoek on a fly, whose larva feeds on flesh, putrid carcases, &c. which multiply prodigiously, and in a short space of time. One of these laid 144 eggs, from which he got as many flies in the first month; so that, supposing one-half of these to be females, in the third month we shall find 746,496, all produced in three months from one fly. M. Lyonet, in order to investigate the generation of a moth, out of 350 eggs produced by a single female, took only 80, from which he obtained, when arrived at their perfect state, 15 females; from whence he deduces the following computation: if 80 eggs give 15 females, the whole brood of 350 would have produced 65, these 65, supposing them as fertile as their mother, would have produced 22,750 caterpillars, among which there would have been at least

4265 females, who would have produced for the third generation 1,492,750 caterpillars. This number would have been much larger, if the number of females among those which were selected by M. Lyonet had chanced to have been greater. M. de Geer counted in the belly of a moth 480 eggs; reducing these to 400, and supposing one fourth only of these to be females and as fruitful as their mother, they will give birth to 40,000 caterpillars for the second generation; and for the third, supposing all things equal, four millions of caterpillars. It is not surprising, therefore, that they are found so numerous in years that are favourable to their propagation. But the Author of Nature has for our sakes limited this abundant multiplication, and wisely ordained, that those species which are the most numerous shall afford food to the greatest number of birds, fishes, &c. who though constantly employed on the destruction of individuals, are unable to effect that of any of the species; by which means an equilibrium is preserved, and no one species preponderates. Few insects live long after their last transformation, but their species are continued by their amazing fecundity; their growth is completed, and their parts hardened, sooner than those of larger animals, and the duration of their existence is proportionably limited.

In the amours of the insect tribes, it is extremely curious to observe the avidity with which the male and female approach each other. The facility with which the males seek out the females is hardly credible. If a female butterfly be concealed in a box, and there be any males within half a mile of the place, they will directly fly to the spot, and hover over it. In some genera the males are not so active, but are eagerly sought and caressed by the females: the incitements of the queen bee to stimulate the passions of the male, are truly wonderful: their mode of

contact is by intromission; an operation which with them requires much time effectually to accomplish; after which the congress continues for many hours. The butterfly and moth are often seen in coitu for a whole day; and the common chafer beetle for upwards of twenty-four hours. But this surprising duration of the sexual embrace appears to be given them, because it is perhaps the only one of their lives, and serves to fecundate the whole mass of eggs in the ovarium of the female. The male is afterwards seen retiring in a very languid state, to some obscure hiding place, where it soon falls a prey to birds or reptiles: the female seeks a nidus wherein to deposit her impregnated store, after which she disappears, and in like manner falls a victim to death; the ends of her existence having been thus fulfilled. Were not this the case, insects would multiply in such countless myriads, that the whole expanse of our globe, and its surrounding atmosphere, would be found too limited to afford them sufficient room. The female, by a very surprising instinct, almost unerringly deposits her eggs where she is certain her progeny will be safely hatched, and supplied with such food, and such means of passing through their transformations, as nature has ordained for them. There are a great number of insects which reject vegetable matter, and seek a nidus for their eggs in putrid flesh, or in living animals. But Reaumur informs us, that those insects which prefer dead flesh never attack living animals; the flesh-fly deposits her eggs in the bodies of dead carcases, where her progeny receive the nourishment best adapted for them; but this fly never attempts to lay her eggs in the flesh of sound and living animals.

The insects which principally deposit their impregnated eggs in the flesh of living animals, and which have not a little perplexed and embarrassed the researches of both ancient and modern naturalists, before

fore they could discover and ascertain their real habits, are the oestri species, commonly called *gad-fly*. The *Oestrus bovis* deposits its eggs in the back of the cattle, under the skin; which, as they are hatched into larvæ, produce a purulent tumour. By the pain it inflicts, in making a nidus for its eggs, an extreme terror and agitation is occasioned, and the object of the attack runs bellowing wildly about, with its tail erect, and in a tremulous motion, and communicates the agitation to the whole affrighted herd. The larva is brown, having eleven segments, with transverse lines. When sufficiently matured, they drop from the nidus, to prepare for their winged state. The *Oestrus equi* deposits its eggs on the hairs or cuticle of horses, and always on those parts which can be licked with the tongue; these, in the egg or larva state, are conveyed with the tongue of the horse, by licking the irritated part, into the stomach; and passing through the intestines with the food, when sufficiently matured, are discharged with the dung. These larvæ are commonly known by the name of *bots*. See Plate II. fig. 19. The hæmorrhoidalis is another kind of *Oestrus*: it deposits its eggs on the lips of horses, occasioning a titillation, which causes the animal, when attacked by it, to move its head violently up and down, and gallop about with every appearance of distress. The larvæ are conveyed through the intestines like those of the other species.—The *Oestrus ovis* deposits its eggs on the inner margin of the nostrils of sheep, occasioning them to shake their heads violently, and hide their noses in dust or gravel. The larvæ crawl up into the frontal sinuses or horns, and when full fed, are again discharged through the nostrils, to prepare for the fly state.—The *Oestrus cuculi*, in like manner, deposits its eggs in the skins of hares and rabbits.—But the most singular of all, is the *Oestrus hominis*, which deposits its eggs under the skin on the bellies of the Indians in South America,

rica, who go nearly naked. The larva, if disturbed, penetrates deeper, and produces an ulcer, which not unfrequently becomes fatal.

Neither the larva, pupa, or even the egg, state, of some insects, are exempt from the attacks of others, who deposit their eggs in like manner upon them; these, after having passed through the usual transformation, become what is termed the *ichneumon* fly. An ingenious entomologist describes the operation as follows: "Observing some caterpillars feeding on a leaf, my attention was attracted by a little ichneumon fly, which appeared as if deliberating where to settle. I was surprised to see the caterpillars endeavouring by various contortions to get out of its way, and more so whenever the fly poised on the wing, as if going to drop. At length the parasite made its choice, and seated itself on the back of one of the largest of the cluster. It was in vain that the caterpillar endeavoured to dislodge the enemy; and its anguish at intervals appeared intolerable, in consequence of the wounds given by the fly. At every wound the poor caterpillar wreathed and twisted its whole frame, endeavouring to disengage the enemy, sometimes aiming its mouth towards the place, but it was all in vain; its little tormenter still kept its place. When it had inflicted thirty or forty wounds, it took its flight with a visible triumph; in each of these wounds the ichneumon had deposited an egg. I took the caterpillar home, to observe the progress of the eggs which were thus placed in its body, taking care to give it a fresh supply of leaves from time to time; it recovered to all appearance from the wounds, and from that time, for the space of four or five days, seemed to feed with its usual avidity. The eggs were all hatched into small oblong voracious worms, which fed from the moment of their appearance on the flesh of the caterpillar, in whose body they were inclosed, and seemingly without wounding the organs of respiration or digestion;

digestion; and when they had arrived at their full growth, they ate their way out of the sides of the animal. These are what have vulgarly been called *caterpillar eaters*. The caterpillar thus attacked by the larva of the ichneumon never escapes, its destruction is infallible; but then its life is not taken away at once; the larva, while it is feeding thereon, knows how to spare the parts which are essential to life, because its own is at that time tied up in that of the caterpillar. No butterfly is produced from the caterpillar; the worms that feed on it are no sooner out of its body, than every one spins its own web, and under this they pass the pupa state, in order to introduce them to their winged form."

The number of insects which feed upon others, nay, some even upon their own species, is very great: it is among these that we find the traces of the greatest art and cunning, as well in attack as defence. Some indeed use main force alone; as does the larva of the *cimex merianæ* of Surinam, which seizes and devours young toads and frogs. Most persons are acquainted with the dexterous arts of the spider, the curious construction of the web he spins, and the central position he takes, in order to watch more effectually the least motion that may be communicated to the meshes of its net.

We cannot close this Introduction without remarking on the extraordinary community and generation of the *termes*, or white ants, insects of the aptera class, and far exceeding in wisdom and policy of the bee, the ant, or the beaver. They are inhabitants of India, Africa, and South America. They build pyramidal structures, ten or twelve feet in height, and divided into appropriate apartments, magazines for provisions, arched chambers, and galleries of communication. These are so firmly cemented, that they easily bear four men to stand upon them; and in the plains of Senegal appear like the huts or tents of the

the inhabitants. With wonderful dexterity and rapidity they destroy food, furniture, books, clothes, and timber, of whatever magnitude, leaving the surface a mere shell. The larva are small, being not half an inch long, six-footed, with a roundish testaceous head, as shewn, fig. 25, in the second Plate; mandibles short, strong, and toothed; antennæ as long as the thorax, and ovate abdomen. These, like the neutral bees, are only the labourers, who build the structures, procure provisions for the males and females, and take care of the eggs; they are also the most numerous. When they reach the pupa state, they are still active, but never work; serve as superintendants over the labourers, or as guards to defend their habitations from intrusion and violence. Whenever a breach is made in the dwelling, they rush forward and defend the entrance with great ferocity; some of them beating with their mandibles against any hard substance, as a signal to the other guards, or as encouragement to the labourers; they then retire, and are succeeded by the labourers, each with a burthen of tempered mortar in his mouth, and who diligently set about to repair whatever injury has been sustained. One of these attends every six or eight hundred labourers who are building a wall, taking no active part himself, but frequently making the signal above-mentioned, which is constantly answered by a loud hiss from all the labourers, who then evidently redouble their diligence. See this state of the insect, fig. 26, in Plate II.

The male and female are nearly alike; but the male, after passing from the pupa state, is furnished with four long horizontal wings. See the female, fig. 16, and the male, fig. 17, in Plate I. These fly abroad in the night; but soon after sun-rise, the wings become dry, and they fall on the ground, and are devoured by birds, or sought after by the inhabitants, who roast and eat them with great avidity.

After

After impregnation, the abdomen of the female grows to a prodigious bulk, exceeding the rest of her body nearly two thousand times: it is then vesicular and white, with transverse brown spots, and an undulate or slightly lobed margin. In this state it contains an immense number of small round brown eggs, which are protruded to the amount of eight thousand in twenty-fours. These are instantly taken up by the labourers, and conveyed to separate chambers, where, after they are hatched, the young are attended and provided for, till they are able to shift for themselves, and take their share in the services of the community.

Yet the works of these busy insects are nothing to the immense labours of the little animals which produce the coral rocks, and which form clusters of islands in the sea.

On the *revivification* of torpid and drowned insects, many curious facts have been related. Common flies, small beetles, spiders, moths, bugs, &c. after being drowned in spirit of wine, and continuing apparently dead, have been restored to life merely by being thrown among wood-ashes slightly warm. While Dr. Franklin resided in France, he received from America a quantity of Madeira wine which had been bottled in Virginia. At the bottom of some of the bottles he found a few dead flies, which he exposed to the warm sun, it being then the month of July; and in less than three hours these apparently dead animals recovered life, which had been so long suspended. At first they appeared as if convulsed; they then raised themselves on their legs, washed their eyes with their fore feet, dressed their wings with those behind, and began in a little time to fly about.

But the most extraordinary instance of revivification that we have seen recorded, is the following: In the warmer parts of France there is an insect very destructive to rye, which seems to begin its operations at the root of the plant, and gradually to proceed

upwards to the ear. If the plant be completely dried while the insect is in the root or stem, the animal is irrecoverably killed; but after it has reached the grain, the case is very different. There have been instances, which are noticed by the academy of sciences at Paris, of these insects being brought to life in a quarter of an hour, by a little warm water, after the grains, in which they were lodged, had been kept dry for thirty years!

Those who wish to take insects for the purpose of forming a collection, should be provided with a gauze clap-net constructed for that purpose. When they are taken, flick a pin through the middle of one of the hard wings, and pass it through the body. They may be killed without injury to their colours or beauty, by immersion in hot water, or in spirit of wine; then stick them on a piece of cork, and afterwards carefully place their legs in a creeping position, and let them continue exposed to the air until all the moisture is evaporated from their bodies.

Butterflies and moths, as well as all flies with membranaceous wings, should be taken with great care, lest the beauty of their plumage be injured. When taken, run a pin through the thorax or shoulders, between the fore-wings. After this is done, the wings should be expanded, and kept so by the pressure of small slips of paper for a day or two. Moths expand their wings when at rest, and they will naturally take that position.

The best method of procuring the most perfect butterflies is to find out, if possible, the larva or caterpillar of each, by examining the plants, shrubs, or trees, they usually feed upon, or by beating the shrubs and trees with long poles, and thereby shaking the caterpillars into a sheet spread underneath to receive them; to put them into boxes covered with thin canvas, gauze, or cat-gut, and to feed them with the fresh leaves of the tree or herb on which they are found;

found; when they are full grown, they will go into the pupa or chrysalis state, and require then no other care till they come out perfect butterflies.

Moths might likewise be procured more perfect, by collecting the caterpillars, and breeding them in the same manner. It may be necessary to observe, that in breeding these kinds of insects, some earth should be put into the boxes, as likewise some rotten wood in the corners; because, when the caterpillars change into the pupa state, some go into the earth, and continue under ground for many months before they come out into the moth state; and some cover themselves with a hard crust, made up of small pieces of rotten wood.

After the insects are properly dried, they may be placed in the cabinet or boxes where they are to remain: these boxes should be kept dry; and also made to shut very close, to prevent small insects from injuring them; the bottoms of the boxes should be covered with green wax, over which paper may be laid; or, which is better, lined with cork, well impregnated with a solution of corrosive sublimate, in a saturated solution of crude sal-ammoniac in water, an ounce of which will dissolve twenty scruples of the sublimate. The finest collections have been ruined by the depredations of small insects; it is impossible, therefore, to have the cabinets too secure. Such insects as are thus attacked may be fumigated with sulphur; if this prove ineffectual, they may be immersed in spirit of wine, without injury. But baking the collection in an oven is the most effectual method of extirpating these enemies when too numerous for partial applications.

CLASSIFICATION.

INSECTS are divided into SEVEN ORDERS, and the Orders into numerous Genera.

K 2

Order

Order I. COLEOPTERA, [from *καλῆος*, a sheath, and *πτερον*, a wing.] Contains all such insects as have crustaceous elytra or shells, called wing-cases, which shut together, and form a longitudinal suture down the back of the insect. These are divided into the following Genera:

Antennæ clavate, thicker towards the tip.—Club lamellate.

- Scarabæus - Fore-shanks toothed.
 Lucanus - Two palpigerous tufts under the lip.
 Synodendron - Jaw one toothed; lip filiform, palpigerous.

Club perfoliate.

- Dermestes - Head inflected under the thorax, which is slightly margined.
 Melyris - Lip clavate, emarginate.
 Byrrhus - Lip extended, bifid.
 Silpha - Thorax and shells margined.
 Tritoma - Anterior feelers hatchet-shaped.
 Hydrophilus - Feelers filiform: jaw bifid, horny.
 Tetratoma - Feelers unequal: jaw bifid, membranaceous.

Club solid and inflated.

- Hister - Head retractile within the thorax.
 Bostrichus - Head inflected under the thorax, which is slightly margined.
 Anthrenus - Jaw bifid.
 Nitidula - Thorax and shells margined.
 Coccinella - Anterior feelers hatchet-shaped.
 Curculio - Snout elongated, horny.
 Pausus - Antennæ two-jointed, the club hooked and inflated.

Antennæ moniliform.

- Brentus - Snout elongated, horny, straight.
 Attelabus - Snout elongated, incurved.
 Erodium - Lip horny, emarginate.
 Staphylinus - Shells half the length of the body, covering the wings: above the tail two exsertile vesicles.
 Zygia - Lip elongated, membranaceous.
 Meloe - Thorax rounded: head gibbous, inflected.
 Tenebrio - Thorax margined: head exserted: body oblong.
 Cassida - Body ovate: shells margined: head covered with a shield.

Opatrum

OF INSECTS.

77

- Opatrum - - Thorax and shield margined.
Mordella - - Laminæ at the base of the abdomen: head inflected.
Chrysomela - - Body ovate, immarginate.
Horia - - Feelers unequal: jaw bifid: lip rounded.

Antennæ filiform.

- Apalus - - Thorax roundish: head gibbous, inflected.
Manticora - - Jaws exerted, toothed: eyes rather prominent.
Pimelia - - Thorax margined: head exerted: body oblong.

- Gyrinus - - Antennæ a little rigid: eyes four.
Cucujus - - Lip short, bifid, the divisions distant.
Cryptocephalus - - Body ovate, immarginate.
Bruchus - - Antennæ growing larger towards the tip.
Ptinus - - Thorax receiving the head: last joints of the antennæ longer.

- Hispa - - Antennæ stretched forward, approximate, fusiform.

- Buprestis - - Head partly retracted within the thorax.
Necydalis - - Shells half as long as the body: wings naked.
Lampyrus - - Shells flexile: thorax surrounding and concealing the head.

- Cantharis - - Shells flexile: sides of the abdomen edged with folded papillæ.

- Notoxus - - Lip bifid: the divisions connivent, obtuse.
Elater - - A pectoral spine springing from an abdominal pore.

- Calopus - - Thorax spinous or gibbous at the sides.

- Alurnus - - Jaw arched: feelers six.

- Carabus - - Thorax obcordate, truncate behind.

- Lytta - - Thorax roundish: head gibbous, inflected.

Antennæ setaceous.

- Serropalpus - - Anterior feelers deeply ferrate.

- Cerambyx - - Thorax spinous or gibbous at the sides.

- Leptura - - Shells tapering towards the tip: thorax roundish.

- Rhinomacer - - Antennæ seated on the snout.

- Zonitis - - Lip emarginate.

- Cicindela - - Jaws exerted, toothed: eyes a little prominent.

- Dytiscus - - Hind legs fringed, formed for swimming.

- Forficula - - Shells half as long as the body: wings covered: tail forked.

Order II. HEMIPTERA, from [*ἡμισ, half, and πτερον, a wing.*] These have their upper wings usually half crustaceous and half membranaceous, not divided

vided by a longitudinal suture, but incumbent on each other. This order contains the following genera :

- Blatta* - - Mouth armed with jaws : wings coriaceous, plane : legs formed for running.
Pneumora - - Mouth armed with jaws : wings membranaceous, deflected : legs formed for running.
Mantis - - Mouth armed with jaws : fore-feet serrate, the claw single.
Gryllus - - Mouth armed with jaws : hind-legs formed for leaping.
Fulgora - - Snout inflected : front projecting, inflated : antennæ capitate.
Cicada - - Snout inflected : hind legs formed for leaping.
Notonecta - - Snout inflected : hind-legs ciliate within.
Nepa - - Snout inflected : fore-legs cheliform.
Cimex - - Snout inflected : legs formed for running : antennæ longer than the thorax.
Macrocephalus - - Snout inflected : antennæ very short.
Aphis - - Snout inflected : abdomen two-horned.
Chermes - - Snout placed in the breast : hind-legs formed for leaping.
Coccus - - Snout placed in the breast : abdomen (in the males) terminating in bristles.
Thrips - - Snout obsolete : wings incumbent on the abdomen, which is reflexile.

Order III. LEPIDOPTERA, [from *λεπίς*, a scale, and *πτερόν*, a wing,] are insects having four wings, covered with fine imbricate scales resembling powder or meal ; as in the butterfly, moth, &c. This order contains three genera, viz.

- Papilio* - - Antennæ thicker towards the tip.
Sphinx - - Antennæ thicker in the middle.
Phalæna - - Antennæ thicker towards the base.

Order IV. NEUROPTERA, [from *νεῦρον*, a nerve, and *πτερόν*, a wing.] These have four membranous transparent naked wings, generally reticulate, or like net-work. This order contains the following genera :

- Libellula* - - Tail-forked : mouth with many jaws : wings expanded.
Ephemera - - Tail with two or three bristles : mouth without teeth : wings erect.
Myrmeleon - - Tail forked : mouth two-toothed : wings deflected.

Phryganea

- Phryganea - Tail simple: mouth without teeth: wings deflected.
 Hemerobius - Tail simple: mouth two-toothed: wings deflected.
 Panorpa - - Tail chelate: mouth with an extended snout: wings incumbent.
 Raphidia - - Tail ending in a single thread: mouth two-toothed: wings deflected.

Order V. HYMENOPTERA, [from *υμεν*, a membrane, and *πτερον*, a wing,] comprehend insects with four membranous wings, and a tail. This order contains the following genera:

- Cynips - - Sting spiral.
 Tenthredo - Sting serrate, two-valved.
 Sirex - - - Sting serrate, projecting from a spine under the abdomen.
 Ichneumon - Sting exerted, triple.
 Spheg - - - Sting pungent: wings smooth: tongue flat, dilated, nearly entire at the end.
 Ammophila - Sting pungent: wings smooth: tongue inflected, bifid.
 Scolia - - - Tongue inflected, trifid: lip membranaceous at the end.
 Thynnus - - Tongue very short, involute: lip trifid.
 Leucopis - Lip longer than the jaw, notched: antennæ clavate.
 Tiphia - - - Lip short, horny, three-toothed.
 Chalcis - - - Antennæ short, cylindrical, fusiform.
 Chrysis - - - Sting pungent: abdomen arched beneath.
 Vespa - - - Sting pungent: upper wings folded.
 Apis - - - Sting pungent: tongue inflected.
 Formica - - Sting obsolete: neuters without wings.
 Mutilla - - Sting pungent: neuters without wings.

Order VI. DIPTERA, [from *δυο*, two, and *πτερον*, a wing,] comprehend all such insects as have only two wings, and poisers or balancers. This order contains the following genera;

With Proboscis and Sucker.

- Diopsis - - Head two-horned: eyes terminal.
 Tipula - - Sucker without a sheath: feelers two, projecting, filiform.
 Musca - - - Sucker without a sheath, furnished with bristles.
 Tabanus

- Tabanus - - Sucker with a single-valved sheath, furnished with bristles.
 Empis - - Proboscis inflected.
 Conops - - Proboscis projecting, geniculate.
 With Sucker, but no Proboscis.
 Oestrus - - Sucker retracted within the perforated lips.
 Asilus - - Sucker straight, two-valved, gibbous at the base.
 Stomoxys - - Sucker with a single-valved convolute sheath, geniculate at the base.
 Culex - - Sheath exerted, one-valved, flexile, with five bristles.
 Bombylus - - Sucker very long, straight, setaceous, two-valved.
 Hippobosca - Sucker short, cylindrical, straight, two-valved.

Order VII. APTERA, [from α , without, and $\pi\lambda\epsilon\gamma\alpha$, a wing,] insects having no wings. This order contains the following genera:

Legs six. Head distinct from the Thorax.

- Lepisma - - Tail ending in setaceous bristles.
 Podura - - Tail forked, inflected, elastic.
 Termes - - Mouth with two jaws: lip horny, four-cleft.
 Pediculus - - Mouth armed with an exsertile sting.
 Pulex - - Snout inflected, armed with a sting: feet formed for leaping.

Legs eight to fourteen. Head and thorax united.

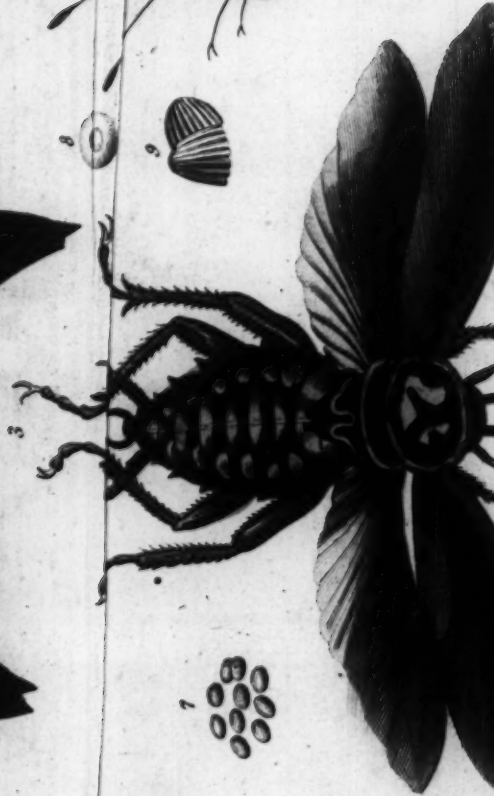
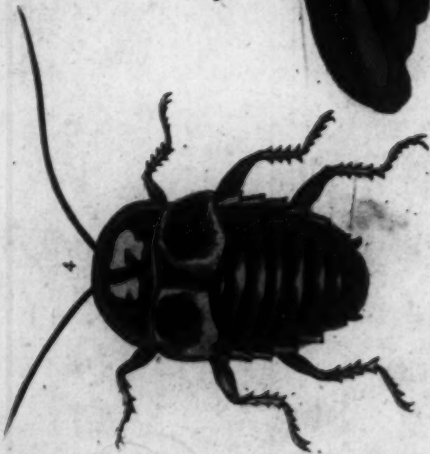
- Acarus - - Eyes two: legs eight: feelers compressed.
 Hydrachna - Eyes two to eight: legs eight: abdomen with textorial papillæ.
 Aranea - - Eyes eight: legs eight: abdomen with textorial papillæ: feelers clubbed.
 Phalangium - Eyes four: legs eight: feelers chelate.
 Scorpio - - Eyes eight: legs eight: feelers chelate.
 Cancer - - Eyes two: legs ten: the first pair chelate.
 Monoculus - Eyes two: legs twelve: ten of them chelate.
 Oniscus - - Eyes two: legs fourteen.

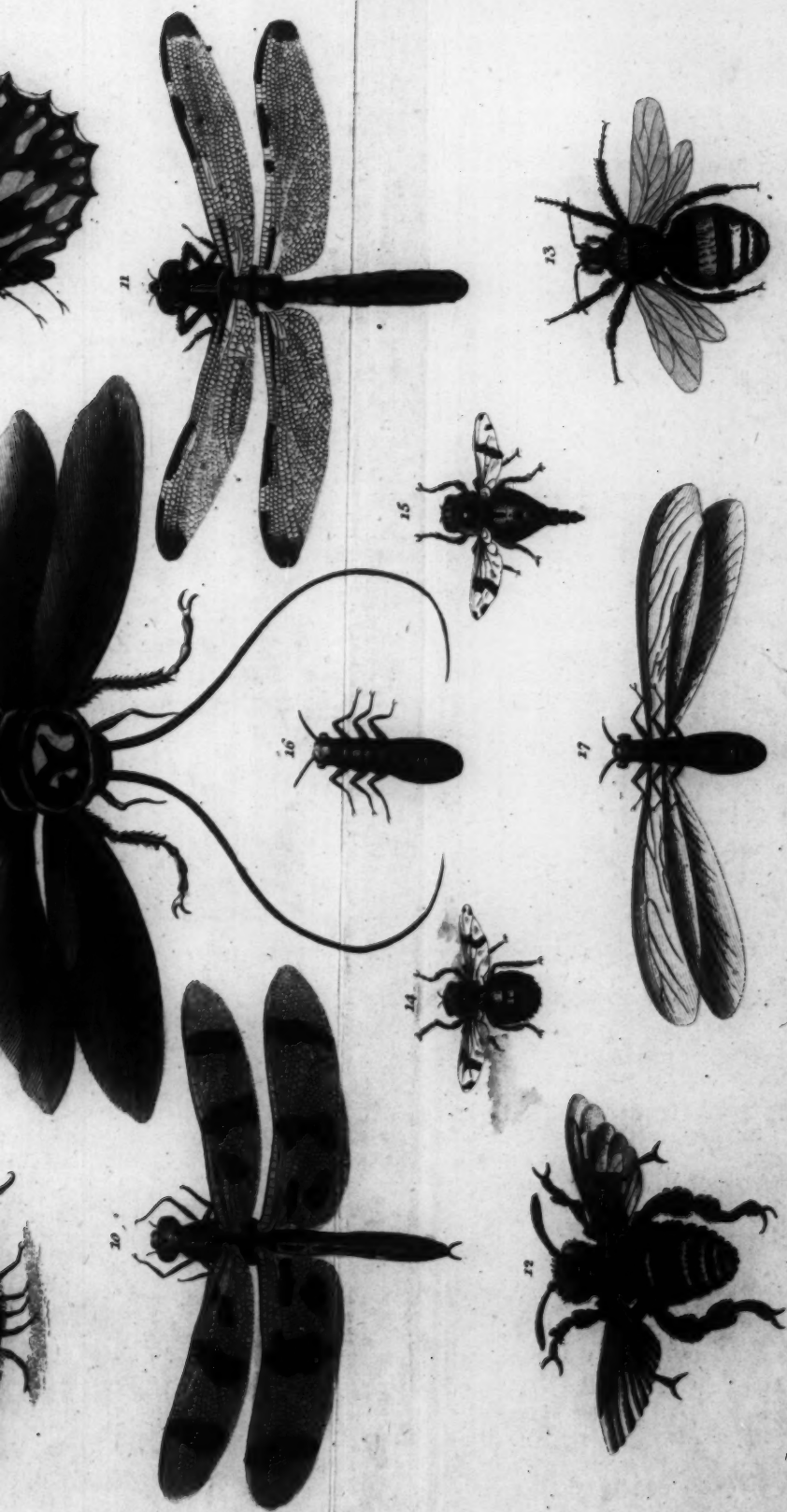
Legs numerous. Head distinct from the Thorax.

- Scolopendra - Body linear.
 Julus - - Body subcylindrical.

The ENTOMOLOGY PLATE I. is calculated to exhibit at one view the construction of the Seven Orders of the INSECTA of Linnæus. Fig. 1, a coleopterus

ENTOMOLOGY.

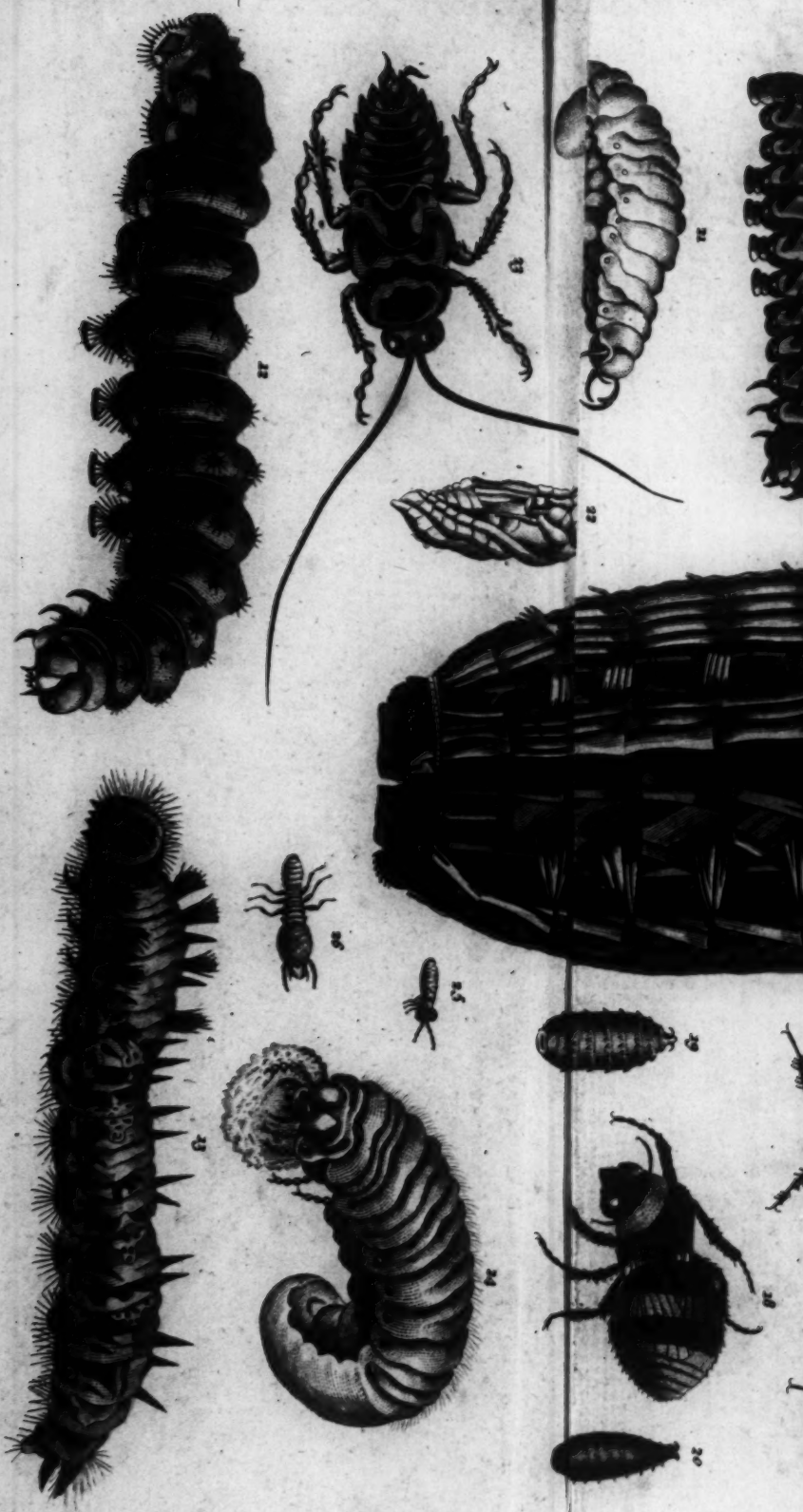




J. Pass. sculpt.

The seven Orders of Insects.

London: Published as the Act directs. Suppl'd by W. Miller.

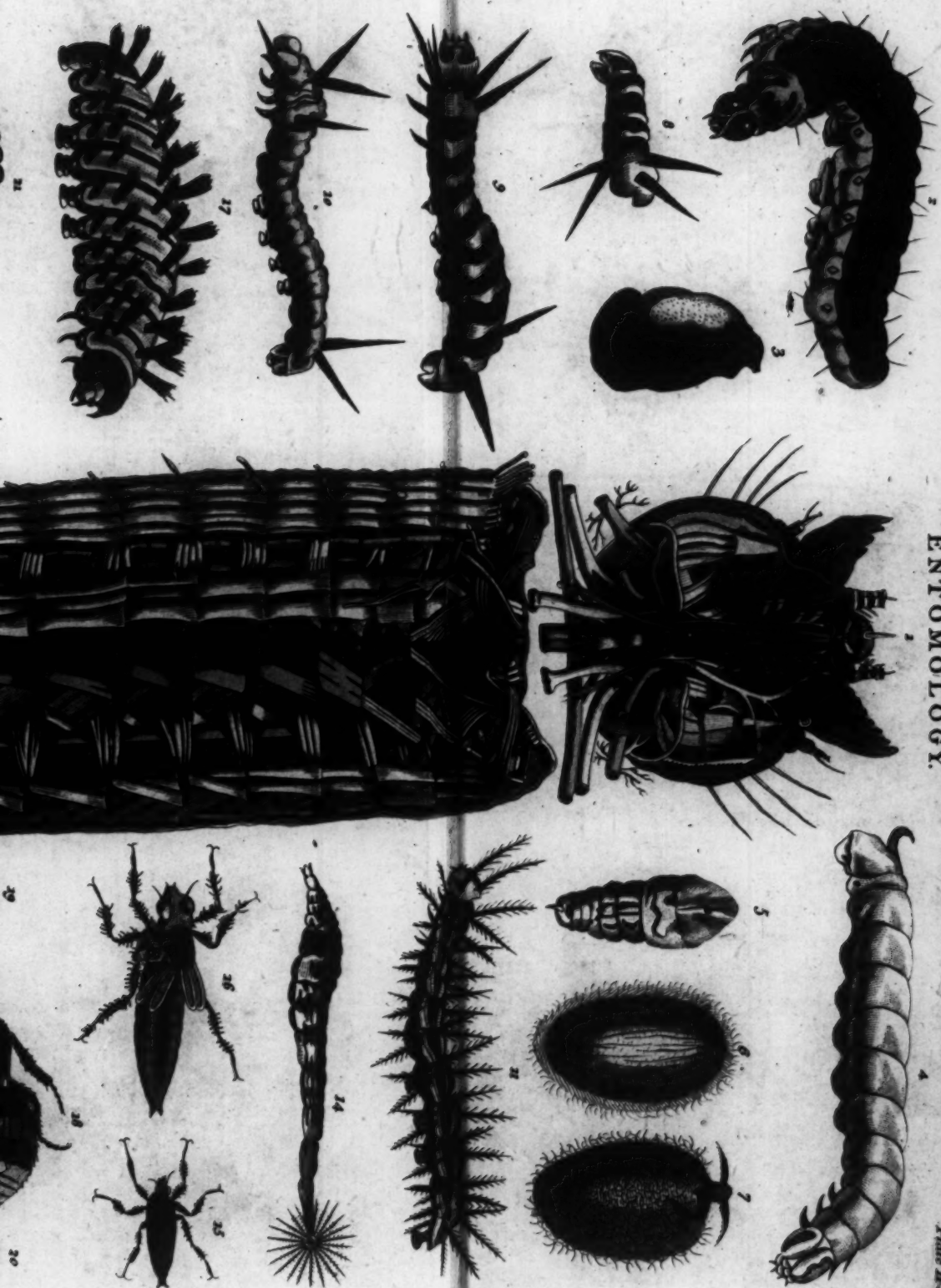


Larvae and Pupae of the Seven Orders of Insects.

London. Published by the author, No. 1, Strand, St. Martin's Lane.

J. M. Smith.

ENTOMOLOGY.



terous insect; the *Buprestis gigantea*. Fig. 2, the female of the same. Fig. 3, an *hemipterous* insect; the *Blatta Americana*. Fig. 4, the female of the same. Under the female at *a*, is shewn the egg of the blatta, with a young larva, *b*, just quickened, and emerging from it. Fig. 5, a *lepidopterous* insect; the *Phalæna coffus*, or goat-moth. Fig. 6, another *lepidopterous* insect; the *Papilio vanillæ*, or butterfly with spiral proboscis. Fig. 7, a bunch of eggs belonging to the goat-moth. Fig. 8, an unimpregnated egg, magnified; and Fig. 9, two fecundated eggs, also magnified, belonging to the butterfly. Fig. 10, a *neuropterous* insect; the *Libellula Carolina*, or male dragon-fly of Carolina. Fig. 11, the female of the same. Fig. 12, an *hymenopterous* insect; the *Apis muscorum*, or mossy humming-bee. Fig. 13, the female. Fig. 14, a *dipterous* insect; the *Oestrus equi*. Fig. 15, its female: this produces the *bots* in horses. Fig. 16, an *apterous* insect; the female of the *Termes fatale*, or white ant. Fig. 17, the male of the same, which, being winged, may, while in this state, be considered as a *neuropterous* insect.

PLATE II. contains figures of the seven orders of insects in the larva and pupa state. Fig. 2, the caterpillar of the *Phalæna coffus*, or goat-moth, of its natural size, and the same animal as dissected and magnified at fig. 1. The pupa of this moth is shewn at fig. 3. The moth itself is shewn at fig. 6, in Plate I. Fig. 4, the silkworm, or caterpillar of the *Phalæna mori*. Fig. 5, the pupa or chrysalis of the same moth. Fig. 6, a section of the cone or follicle of silk, in which the pupa incloses itself. Fig. 7, the cone or follicle, shewing the moth in the act of making its way out, and just arrived at its imago or fly state. Fig. 8, the caterpillar of the *Phalæna erythrinæ*, in its first worm-state. Fig. 9, the same caterpillar, after its first moult. Fig. 10, the same after its second moult. Fig. 11, the caterpillar of the *Pa-*

pilio vanillæ, or butterfly with the spiral tongue, shewn in Plate I. fig. 6. Fig. 12, caterpillar of the atlas moth. Fig. 13, caterpillar of the Achilles butterfly. Fig. 14, the larva of the *Musca chamæleon*. Fig. 15, the larva of the *Libellula*, or dragon fly. Fig. 16, the pupa of the same, with its wings beginning to evolve. Fig. 17, the palmer, or caterpillar of the *Apis muscorum*, or humming-bee. Fig. 18, the pupa of the same, with the rudiments of its wings. See the perfect fly, male and female, fig. 12, 13, in Plate I. Fig. 19, the larva of the *Oestrus equi*, or grub called the ~~dog~~, voided by horses. Fig. 20, the pupa of the same. For the perfect fly, male and female, see fig. 14, 15, in Plate I. Fig. 21, the larva of the *Lucanus interruptus*, or black beetle with yellow wings. Fig. 22, the same in its pupa state, shewing the rudiments of its limbs. Fig. 23, the larva of the *Blatta Americana*; the perfect insects, male and female, are shewn at fig. 3, 4, in Plate I. Fig. 24, the larva of the *Buprestis gigantea*. The perfect beetles, male and female, are exhibited at fig. 1 and 2, Plate I. Fig. 25, the larva of the *Termes fatale*, or white ant. Fig. 26, the pupa of the same. See the perfect insects, fig. 16 female, and 17 male, in Plate I.

We may expect great improvements in the science which is the subject of this volume from a society lately established called the Entomological Society of London. Its pursuits are directed towards the study of entomology in general, but more especially of those species of insects found in Great Britain; the ascertaining of their names and distinctions, their native countries, their localities, their food, economy, and peculiarities; pointing out the readiest and most desirable methods of destroying those which possess noxious properties, and making known, as far as possible, those properties, which may either prove useful to science, or beneficial to mankind.

The

The first Part of the first Volume of the Transactions of this Society was published in September last, (1807.) It opens with a paper called, "A Review of the Rise and Progress of the Science of Entomology in Great Britain, chronologically digested." From this it appears, that the first work published in England, relating to Entomology, was a large folio volume, written and completed by Thomas Moufet, entitled, *Insectorum, five minimorum Animalium*. It was published at London, in 1634, embellished with numerous engravings on wood, accompanied by long, tedious, and sometimes superstitious, descriptions of the subjects they represent. The figures are wretchedly executed, yet the book is not destitute of merit. The first publication, which gave any account of British insects exclusively, was published in 1667, by Christopher Merret, M. D. F. R. S. and contains, amongst other things, a brief catalogue of such as Dr. M. knew to be indigenous, each accompanied by a concise descriptive sentence, by way of name. We can do little more than mention the names of the succeeding writers on entomology, beginning with Dr. Martin Lister, of York; Petiver, whose museum, after his death in 1718, was purchased by Sir Hans Sloane, for £4000, and now forms part of the stores of the British Museum; Sir Hans Sloane; the great Ray, whose *Historia Insectorum* was published after his death, by Dr. Derham; Eleazer Albin, who published, in 1731, *The Natural History of British Insects*, which contains principally, but not exclusively, such lepidopterous insects as the author and his friends had reared from the state of caterpillars, exhibiting them feeding on their proper plants, and in all their changes; the whole are highly coloured, and accompanied by descriptions in English. This author also published, in 1736, a *Natural History of Spiders*, in which he enumerates nearly two hundred species, and gives an English description of

K 2

each;

each; Professor Bradley, whose multifarious works on agriculture, horticulture, and in various branches of natural history, shew more industry than science; he mentions the Duchess of Beaufort, as "having bred a greater variety of English insects than were ever rightly observed by any one person in Europe."

From this time (1739) to 1758, no publication on the subject of entomology appeared, when Dr. John Hill published, in folio, an English translation of Swammerdam's large work on Insects, and in 1773 he also published, A Decade of curious Insects, some of them not described before; some observations on the ninth, the *Alucita pallida*, (straw-coloured chinch,) it may be worth while to give here, especially as the practice of keeping the plant alluded to, both in our bed rooms and sitting rooms, seems to be rapidly increasing on account of its fragrance. "This is a creature, says Dr. Hill, very strange in its nature and history, and once came as strangely before me. A studious gentleman, very subject to the head-ache, which he and his physician both attributed to great attention, sneezing one day with violence as he was writing, saw some atoms a moment afterwards upon the writing paper, and they plainly moved; he doubled up the paper and brought it to me, when we laid a parcel of these moving particles before the lucernal microscope, when they appeared in continual motion, vibrating their antlers, shaking their wings, and turning up their tails to their heads in the manner of earwigs, but with incredible swiftness. 'Twas palpable they had been discharged from his nose, and 'tis easy to see from whence they were thrown, and to understand how they might have caused intolerable pain, whilst they were thus rousing and moving their irritating hairs and feathers, upon a part where the very substance of the brain is almost naked. I had seen the same species inhabiting the flowers of the plant, mignonette,

OF COLEOPTEROUS INSECTS. 85

mignonette, and, on enquiring, found that he had that plant in his chamber."

The following list of names will shew the writers on entomology in Great Britain, since 1758; Dr. Berkenhout; John Reinhold Forster; Dr. Lettsom; Dr. Drury, F.L.S.; Benjamin Wilks; T.P. Yeates; W. Curtis, F.L.S.; Moses Harris; James Barbut; Mathew Martyn; Dr. Shaw; E. Donovan; Thomas Martyn; William Lewin, F.L.S.; John Francillon; Dr. J. E. Smith, P.L.S.; Dr. Turton; Rev. M. Kirby; A. H. Haworth, F.L.S. and P.E.S.; Thomas Marsham, F.L.S. and James Sowerby, F.L.S. An appendix to this paper, contains the names of Francis Willoughby, and Sir Robert Sibbald, M. D.

We now proceed to a more particular description of each genus, with an account of the most remarkable species.

ORDER I. COLEOPTEROUS INSECTS.

THIS order includes such insects as have wings covered with crustaceous shells. The genera are fifty-seven in number, as already enumerated at p. 76. But we shall place them in the succession adopted by Dr. Turton.

SCARABÆUS, THE BEETLE.

GENERIC characters, Antennæ or horns clavate, with lamellated tip; feelers four; fore-legs generally toothed. The species are no less than 546 in number; and so great is the diversity of appearance in the various kinds, that the most romantic imagination can hardly conceive a structure of horn or process which is not exemplified in some of the species. The larvæ or grubs have six feet, and live quietly under ground; most of them delight in, and feed on, dung; but some on decayed wood, and a few on the leaves of plants. For more information on the general habits of the beetle, see p. 46 of this volume.

The

The HERCULES BEETLE, *Scarabæus Hercules*.

This species extends to five, or even six, inches in length. The wing-shells are of a smooth surface, of a bluish or brownish grey colour, sometimes nearly black, and commonly marked with several small round deep-black spots, of different sizes. The head and limbs are coal-black: from the upper part of the breast or thorax proceeds a horn or process of enormous length in proportion to the body: it is sharp at the tip, where it curves slightly downwards, and is marked beneath by two or three denticulations, and furnished throughout its whole length with a fine, short, velvet-like, pile, of a brownish orange-colour; from the front of the head proceeds also a strong horn, about two thirds the length of the former, toothed on its upper surface, but not furnished with any of the velvet-like pile which appears on the former. This species is a native of several parts of South America, where great numbers are said to be sometimes seen on the tree called the Mammæa, rasping off the rind of the slender branches by working nimbly round them with the horns, till they cause the juice to flow, which they drink to intoxication, and thus fall senseless from the tree. This, however, as the learned Fabricus has well observed, seems not very probable; since the thoracic horn, being bearded on its lower surface, would undoubtedly be made bare by this operation.

This beetle, from the large size of all its parts, affords an admirable example of the characters of the genus. It varies much in size, and it may even be doubted whether some of the smaller specimens have not been occasionally regarded by authors as distinct species. The female is destitute both of the frontal and thoracic horn, but in other points resembles the male.

The

The BULL-COMBER, *Scarabæus typhæus*.

This species is not very frequent in Britain; and is of a very singular conformation. The body is broad and short; the elytra have longitudinal streaks that disappear gradually as they proceed along its sides; the head projects forward, and the antennæ are very apparent. The colour of this insect is black, except the inferior parts of the body, which are partially covered with a few vibrissæ of a brown colour. What particularly distinguishes the typhæus is the peculiar form of the thorax; the two lateral points of which project beyond the head, having a small protuberance upon the side, whilst the middle point is shorter and somewhat raised. These long projecting horns seem given to the insect as offensive weapons, although it is incapable of using them. It is not always that the members of this tribe of beings are applied to the purposes that seem most obvious and natural to the observer.

The resemblance which these thoracic horns bear to the long spears carried by the soldiers of the Macedonian phalanx, has occasioned the name of *phalangist*, which the French naturalists apply to this insect. The larvæ of the typhæus is most commonly found in cow-dung, where the grown animal is also frequently to be seen, both for the purpose of collecting food and depositing its eggs.

The CAROLINE BEETLE, *Scarabæus Carolinus*,

This is shown at fig. 5. on the annexed Plate. It is black, obtuse, gibbous, and about a finger thick. The thorax is retuse, with two knobs; the horn of the head erect, but very short. Shield entire; shells grooved.

The DUNG-BEETLE, *Scarabæus pilularis*.

Remarkable for choosing the most filthy residence,
heaps

heaps of dung, and excrementitious matter. There are several other species nearly resembling it, in the impurity of its habits, as well as its external form. The dung-beetle, which is here selected for description, is smooth and of a black colour above, some mixed with green; on the lower side there are a few straggling vibrissæ. The head resembles a hood, raised in the middle, and projecting at the edges: the jaws extend beyond the head. The thorax has a groove in the middle; its circumference is margined, and its figure is round and smooth. The elytra are ornamented with a great number of longitudinal streaks: underneath the colours are various and brilliant, consisting of different shades of blue and green. There is observable on the anterior thighs, a spot formed by some red hairs, which, however, in some subjects is wanting. The tarsi appear weak and slender in proportion to the thighs, and this is uniformly the case with all the feet.

The CARNIFEX BEETLE, *Scarabæus carnifex*.

Shown in two positions at fig. 2 and 3 of the Plate of Beetles. This, like the dung-beetle, forms round balls of excrement to deposit its eggs in. The body is broad, and depressed; of a brassy hue; the thorax angular, rough; horn of the head inflected. Inhabits America.

**The TREE BEETLE, OR COCKCHAFER;
Scarabæus melolontha.**

This insect is extremely familiar in our own island, the larva or caterpillar inhabiting ploughed lands, and feeding on the roots of corn, &c. and the complete insect making its appearance during the middle and the decline of summer.

The cockchaffer sometimes appears in such prodigious quantities as almost to strip the trees of their foliage, and to produce mischiefs nearly approaching
to

to those of the locust tribe. It appears from a paper by a Mr. Molineux, printed in the Philosophical Transactions for the year 1697, that some particular districts in Ireland were overrun by this insect in a wonderful manner. The account runs as follows. " These insects were first noticed in this kingdom in 1688. They appeared on the south-west coast of Galway, brought thither by a south-west wind, one of the most common, I might almost say trade-winds, of this country. From hence they penetrated into the inland parts towards Heddsford, about twelve miles north of the town of Galway: here and there in the adjacent country multitudes of them appeared among the trees and hedges in the day-time, hanging by the boughs in clusters, like bees when they swarm. In this posture they continued, with little or no motion, during the heat of the sun; but towards evening or sunset, they would all disperse and fly about with a strange humming noise like the beating of distant drums, and in such vast numbers that they darkened the air for the space of two or three miles square. Persons travelling on the roads, or abroad in the fields, found it very uneasy to make their way through them, they would so beat and knock themselves against their faces in their flight, and with such a force as to make the place smart, and leave a slight mark behind them. In a short time after their coming, they had so entirely eaten and destroyed all the leaves of the trees for some miles round, that the whole country, though in the middle of summer, was left as bare as in the depth of winter, and the noise they made in gnawing the leaves made a sound much resembling the sawing of timber. They also came into the gardens, and destroyed the buds, blossoms, and leaves, of all the fruit-trees, so that they were left perfectly naked; nay, many that were more delicate than the rest lost their sap as well as leaves, and quite withered away, so that they never recovered

again. Their multitudes spread so exceedingly that they infested houses, and became extremely offensive and troublesome. Their numerous young, hatched from the eggs which they had lodged under ground, near the surface of the earth, did still more harm in that close retirement than all the flying swarms of their parents had done abroad; for this destructive brood, lying under ground, ate up the roots of corn and grass, and thus consumed the support of both man and beast. This plague was happily checked several ways. High winds and wet weather destroyed many millions of them in a day; and when this constitution of the air prevailed, they were so enfeebled that they would let go their hold, and drop to the ground from the branches, and so little a fall as this was sufficient quite to disable, and sometimes to kill, them. Nay, it was observable that, even when they were most vigorous, a slight blow would for some time stun them, if not deprive them of life. During these unfavourable seasons of the weather, the swine and poultry of the country would watch under the trees for their falling, and feed and fatten upon them; and even the poorer sort of the country people, the country then labouring under a scarcity of provision, had a way of dressing them, and lived upon them as food. In a little time it was found that smoke was another thing very offensive to them, and by burning heath, fern, &c. the gardens were secured, or, if the insects had already entered, they were thus driven out again. Towards the latter end of summer, they of themselves so totally disappeared, that in a few days you could not see one left. A year or two ago, all along the south-west coast of the county of Galway, for some miles together, there were found dead on the shore such infinite multitudes of them, and in such vast heaps, that, by a moderate estimate, it was computed there could not be less than forty or fifty horse-loads in all; which was a new colony, or a supernumerary swarm from the same place

place whence the first stock came, in 1688, driven by the wind from their native land, which I conclude to be Normandy or Britany in France, it being a country much infested with this insect, and from whence England heretofore has been pestered in a similar manner with swarms of this vermin; but these, meeting with a contrary wind, before they could land, were stopped, and, tired with the voyage, were all driven into the sea, which, by the motion of its waves and tides, cast their floating bodies in heaps on the shore. It is observed that they seldom keep above a year together in a place, and their usual stages or marches are computed to be about six miles in a year. Hitherto their progress has been westerly, following the course of that wind which blows most commonly in this country."

It is recorded by Mouffet, in his History of Insects, that in the year 1574, in the month of February, so great a quantity of these insects were driven into the river Severn, that they totally prevented the mills from working, and were with difficulty extirpated by the united efforts of the people, and the various kinds of hawks, ducks, and other birds, which preyed upon them with avidity. In Normandy, according to the same author, they generally make their appearance every third year. In our own island the county of Norfolk seems occasionally to have suffered most from the ravages of the cockchaffer. In the year 1751 in particular many crops are said to have been destroyed by it.

The GOLIATH BEETLE, *Scarabæus goliathus*.

Remarkable both in point of size and colour. It has a rose-coloured thorax, marked with longitudinal black stripes or variegations, and purple-brown wing-sheaths: the head is divided in front into two forked processes: the limbs are black, and very strong. It is a native of some parts of Africa. See the Plate, fig. 1.

The GOLDEN BEETLE, *Scarabæus auratus*.

This species of the beetle is deemed the most beautiful of the English insects. The whole body is of a glossy green, tinged with yellow; underneath, these colours partake of a shade of red, which some naturalists have compared to leather, others to finely-polished copper. In the brilliancy of its hues it rivals the emerald, and has sometimes been distinguished by that name. In its vermicular state it remains on the surface of the ground, or covered to a little depth with the mould; there it preys on the roots of tender plants. After it is transformed into a winged insect, it chiefly delights in the flowers of the rose and piony: it is consequently an inhabitant of the gardens, where its transient beauty is reckoned a small compensation for the mischief of which it is guilty. In the impure abode of the dung-beetle, that animal may be less pleasing to the spectator; but in return it is productive of less harm, and is less exposed to injury in a dwelling of which it remains the unenvied possessor.

The SULCATED BEETLE. *Scarabæus fulcatus*.

This species is from the Brasils. It is of a brassy-green colour, polished, without spots in the thorax; shells grooved. Shown on the Plate at fig. 4.

LUCANUS, THE STAG-CHAFER.

GENERIC characters, Antennæ clavate, with compressed tip, divided into short pectinate leaves; jaws projecting beyond the head, so as to resemble horns, and toothed; two palpigerous tufts under the lip.

These are the largest of British insects; and they differ chiefly from the beetles, properly so called, in having the jaws so elongated as to resemble horns; while the real horns terminate in a laterally-flattened tip

tip divided into lamellæ on the inner side. They inhabit Great Britain in general, but are most frequent in Kent and Sussex. There are 26 species.

The STAG-CHAFER, OR STAG-BEETLE;

Lucanus cervus.

This is readily distinguished by its superior magnitude, which entitles it to the first rank among the insect tribes. It is however characterised by another peculiarity no less singular, and that is the large moveable jaws, resembling in form the horns of a stag. These instruments are broad and flat, projecting from the head nearly one third of the animal's length; they have in the middle, towards the inner part, a small branch, and at their extremity are forked. Their similarity in shape to the horns of the stag has struck every naturalist, and has procured for the insect the appellation of the *flying stag*. The horns are sometimes as red as coral, which gives these animals a very beautiful appearance. The head that supports these romantic horns, is broad, short, and irregular; and the thorax, which intervenes between it and the body, is narrower than either, and margined around. The elytra of this beetle are very plain, being unadorned with either streaks or lines. The colour of the whole animal is uniformly of a deep brown.

This remarkable insect is chiefly found in the neighbourhood of oak trees, delighting in the sweet exudation or honey-dew so frequently observed on the leaves. Its larva, which perfectly resembles that of the genuine beetles, is also found in the hollows of oak trees; residing in the fine vegetable mould usually seen in such cavities, and feeding on the softer parts of the decayed wood. It is of very considerable size, of a pale yellowish or whitish brown colour, and when stretched out at full length, measures nearly four inches. When arrived at its full
size,

size, which, according to some, is hardly sooner than the fifth or sixth year, it forms, by frequently turning itself, and moistening it with its glutinous saliva, a smooth oval hollow in the earth in which it lies, and afterwards remaining perfectly still for the space of near a month, divests itself of its skin, and commences pupa or chrysalis. It is now of a shorter form than before, of a rather deeper colour, and exhibits in a striking manner the rudiments of the large extended jaws and broad head so conspicuous in the perfect insect: the legs are also proportionably larger and longer than in the larva state. The ball of earth in which this chrysalis is contained is considerably larger than a hen's egg, and of a rough exterior surface, but perfectly smooth and polished within. The chrysalis lies about three months before it gives birth to the complete insect, which usually emerges in the months of July and August. The time however of this insect's growth and appearance in all its states varies much, according to the difference of seasons.

The commonly-supposed female differs so much in appearance from the male, that it has by some authors been considered as a distinct species. It is not only smaller than the former, but totally destitute of the long and large ramified jaws, instead of which it has a pair of very short curved ones, slightly denticulated on their inner side: the head is also of considerably smaller diameter than the thorax. In point of colour it resembles the former. Among those who consider it as a distinct species may be numbered the ingenious Mr. Marshall, F. L. S. who, in his *Entomologia Britannica*, assures us that the real female insect extremely resembles the male, but is smaller, and wants the larger denticulation on the inner side of each horn.

The

The PARALLELOPIPED CHAFFER. *Lucanus parallelopipedus.*

The body of this species is black; the horns smaller than those of the preceding, which in other respects it nearly resembles, and the body is oblong, and of that shape expressed by the Linnæan name. It frequents the meadow-grounds, and its habits are therefore probably different from those of the stag; but very little relating to its economy is known.

DERMESTES, THE DERMESTES.

GENERIC characters, Antennæ clavated, with three of the joints thicker than the rest; the breast is convex; and the head is inflected or hidden under the thorax. The larvæ or grubs of this tribe devour dead bodies, skins, leather, or any animal substance, books, &c. and will perforate any kind of wainscot, or household furniture. There are 85 species now ascertained, which are in general smaller than the insects we have hitherto examined, but of superior beauty. Many of the insects belonging to this genus exhibit a variety of the richest colouring that flows even from nature's pencil. They are near neighbours of man, and often troublesome companions: one species, the *lardarius*, is destructive to meat, and is very difficult to prevent from entering into the repositories of the cook. It is a still more unwelcome intruder into the cabinets of the curious; being very destructive to birds, insects, and other subjects of natural history, in a state of preservation. Arsenic is the most certain preventative against its depredations there.

The BACON-EATER, *Dermestes lardarius.*

This is of an oblong-form, and black colour, distinguishable by a light brown stripe or patch that occupies transversely almost the anterior half of each of the elytra. That colour depends on small-grey hairs situated

situated on that part. The stripe is irregular at its edges, and intersected through the middle by a small transversal streak of black spots, three in number on each of the elytra, the middlemost somewhat lower than the others, which gives the black streak a serpentine form. Its larva is oblong, somewhat hairy, and divided into segments alternately dark and light coloured; gnaws and destroys preparations of animals and birds preserved in collections, and even feeds upon the insects; it is also to be found in old bacon.

The FLESH-EATER, *Dermestes violaceus*.

In this species the elytra are of a deep violet blue. The thorax is covered with greenish hairs, the legs are black. The whole animal is of a glittering brilliancy, which renders it a pleasing insect. The larva, as well as the perfect insect, inhabits the bodies of dead animals.

The DUNG-EATER, *Dermestes fumatus*.

Colour light brown, except the eyes, which are black. It is, however, sometimes more or less deep. The thorax is margined, and the insect has the whole carriage of a scarabæus; but its antennæ have the character of those of the dermestæ. This little creature is found in dung. It also finds its way into houses.

The FURNITURE-EATER, *Dermestes domesticus*.

The form of the insect is oblong, and almost cylindrical: The elytra are striated; the thorax thick and gibbous. There are many varieties, differing considerably both in size and colour; some being found of a dark brown, and others of a much lighter hue. When touched, it instantly draws back its head under the thorax, and its feet under the abdomen, remaining

remaining motionless in that position till the danger is over.

Of all insects this is the most destructive to wooden furniture, where it is found in vast numbers, in the larva state perforating it into those small round holes that appear on the external surface, while the inner parts are reduced to powder. There are few kinds of wood so hard as to be proof against the attacks of these animals, after they have remained long enough out to be drained of their natural juices. It does not seem to be ascertained how the eggs of this animal came at first to be deposited in timber: it would seem, that the winged animal which produces them has the power of perforating cells for their reception; but it is evident, that the young in their larva state have a much greater degree of voracity than the perfect animals. The acrid varnish, which is now extracted in such abundance from coal, promises to be the most effectual remedy against their encroachments.

BOSTRICHUS, THE BOSTRICHUS.

GENERIC characters, Antennæ clavate, solid at the tip; thorax convex, slightly margined; head inflexed, and hid under the thorax. A fertile and voracious tribe, consisting of 30 species; they are very destructive to wood, by making those deep irregular channels so often observed in the bark and wood of trees.

The YELLOW-HORNED BOSTRICHUS, *Bostrichus flavicornis*.

Prevailing colour rufous; shells black, spinous, and toothed at the tip; antennæ yellow. This is a small species, inhabiting North America. Thorax cylindric; club of the antennæ compressed; shells striate and toothed, the hind tooth elongated into a spine. Under part of the body, and legs, brown.

The CYLINDRIC BOSTRICHUS, *Bostrichus cylindrus*.

Colour black; shells striate, downy at the tip, and toothed; legs compressed, testaceous. In this also the antennæ are yellow, the club large and compressed. Inhabits Germany, in the oak.

The ENGLISH BOSTRICHUS, *Bostrichus scolytus*.

General colour blackish, and smooth, front ashy, downy; shells truncate, striate, a little longer than the abdomen, which is retuse. Inhabits England, in the bark of the elm.

SYNODENDRON, THE SYNODENDRON.

THIS genus seems to have been formed by Dr. Turton, out of the *Scarabæus* and *Bostrichus* genera of Gmelin. It consists of four species, one from the former genus, two from the latter, and one lately brought from South America. The generic characters are, Antennæ clavate, lamellate at the tip; thorax gibbous, and muricate or unequal; lip filiform, horny, palpigerous at the tip.

MELYRIS, THE MELYRIS.

ADOPTED by Gmelin from Fabricius, who described two species, to which Dr. Turton has added one. Generic characters, Antennæ entirely perfoliate; head inflexed under the thorax, which is margined; lip clavate, emarginate; jaw one-toothed, pointed.

Two of the species are green, and one black, each with three raised lines on the shells; but the descriptions we have of them are so short, that they would convey little information to the reader.

PTINUS, THE PTINUS.

GENERIC characters, Antennæ filiform, the three last joints the largest; thorax roundish, without any distinct

OF COLEOPTEROUS INSECTS. 99

distinct margin, and receiving the head occasionally beneath it. This genus consists of 39 species of small insects, which, in general, have similar habits, living both in their larva and complete state among dry animal substances, and some species in dry wood, committing great havock among the older articles of furniture, which they pierce with innumerable holes, thus causing their gradual destruction. To this genus belongs the celebrated insect distinguished by the title of

The DEATH-WATCH, *Ptinus pulsator*.

Among the popular superstitions which the almost general illumination of modern times has not been able to obliterate, the dread of the death-watch may well be considered as one of the most predominant, and still continues to disturb the habitations of rural tranquillity with groundless fears and absurd apprehensions. It is not indeed to be imagined that they who are engaged in the more important cares of providing the immediate necessities of life should have either leisure or inclination to investigate with philosophic exactness the causes of a particular sound: yet it must be allowed to be a very singular circumstance that an animal so common should not be more universally known, and the peculiar noise which it occasionally makes be more universally understood. It is chiefly in the advanced state of spring that this alarming little animal commences its sound, which is no other than the call or signal by which the male and female are led to each other, and which may be considered as analogous to the call of birds; though not owing to the voice of the insect, but to its beating on any hard substance with the shield or fore-part of its head. The prevailing number of distinct strokes which it beats is from seven to nine or eleven; which very circumstance may perhaps still add in some degree to the ominous character which it bears among

the vulgar. These sounds, or beats, are given in pretty quick succession, and are repeated at uncertain intervals; and in old houses, where the insects are numerous, may be heard at almost every hour of the day; especially if the weather be warm. The sound exactly resembles that which may be made by beating moderately hard with the nail on a table. The insect is of a colour so nearly resembling that of decayed wood, viz. an obscure greyish brown, that it may for a considerable time elude the search of the enquirer. It is about a quarter of an inch in length, and is moderately thick in proportion, and the wing-shells are marked with numerous irregular variegations of a lighter or greyer cast than the ground-colour.

In the twentieth and twenty-second volume of the Philosophical Transactions may be found a description of this species by the celebrated Derham, with some very just observations relative to its habits and general appearance; and it seems singular that so remarkable an insect should have almost escaped the notice of more modern entomologists. In the twelfth edition of the *Systema Naturæ* of Linnæus it does not appear; but is probably the *Dermestes tessellatus* of Fabricius, in which case he seems to have placed it in a wrong genus. Ridiculous and even incredible as it may appear, it is an animal that may in some measure be tamed: at least, it may be so far familiarized as to be made to beat occasionally, by taking it out of its confinement, and beating on a table or board, when it will readily answer the noise, and will continue to beat as often as required.

We must be careful not to confound this animal, which is the real death-watch of the vulgar, emphatically so called, with a much smaller insect of a very different genus, which makes a sound like the ticking of a watch, and continues it for a long time without intermission. It belongs to a totally different order, and is the *Termes pulsatorium* of Linnæus.

HISTER,

HISTER, THE HISTER.

THERE are 24 species enumerated under this genus, all varying in size, but uniformly of a dark colour: in some the elytra are striated, in others spotted; while some are smooth and uniform in their colour. The larvæ, as well as the winged insects, reside most frequently in the dung of horses and cows, and often upon sand. The generic characters are drawn from the shape of the antennæ, the last articulation of which is larger than the others, and terminates in a solid knob, while the first articulation is compressed and incurvated; the mouth is forcipated; the head drawn back occasionally within the body; and the fore-legs are dentated.

The ONE-COLOURED HISTER, *Hister unicolor*.

This is one of the most beautiful insects belonging to the tribe. The body is black, polished, and brilliant. The figure of the animal is almost square; the thorax large, and highly polished, having a slight margin that bounds its circumference; the anterior part is formed with a slope, into which the head is withdrawn so completely, that it is only perceptible by the projection of the maxillæ. From this situation of the head, the insects of this genus often seem altogether deprived of that part. The elytra end abruptly, as if cut away by the middle, before they reach the whole length of the abdomen: they are smooth, having only a few striæ on the outer side, that are scarcely perceptible.

GYRINUS, THE GLIMMER-CHAFER.

GENERIC characters, Antennæ clavated, stiff, shorter than the head; eyes apparently four, two above and two below the antennæ. Linnæus calls the antennæ *cylindrical*; but Dr. Shaw observes, that, if inspected with a magnifier, they will be found to consist

consist of very numerous close-set joints. The eyes are so placed as to appear double on each side the head; however they are but two in all. There are 11 species, mostly found on the surface of waters, on which they run and describe circles with great celerity; when attempted to be taken, they plunge to the bottom, drawing after them a bubble resembling a globule of quicksilver.

The WATER-FLEA, *Gyrinus natator*.

This insect is about a quarter of an inch in length, of an oval shape, with somewhat sharpened extremities, and of a black, or grey-black colour, with so lucid a surface as to shine like a piece of looking-glass in the sun. It is an inhabitant of the waters, and is chiefly found in rivulets, being generally seen in great multitudes, and in very brisk motion. It is difficult to catch, diving with astonishing celerity when disturbed; the hinder legs being very broad, finely webbed with minute hairs, and most curiously formed for exercising the office of fins or oars. The larva is of a highly singular aspect, having a very lengthened body, furnished, exclusive of six legs on the fore-parts, with a great many lateral appendages or processes down the body; those towards the extremity considerably exceeding the rest. In its motions it is extremely agile, swimming in a kind of serpentine manner, and preying on the smaller and weaker water-insects, minute worms, &c. The head is armed with a pair of forceps, pierced on each side the tip with a small foramen, through which it sucks the juices of the animals on which it preys: the colour of this larva is a very pale or whitish brown, with a high degree of transparency, which renders it a very curious object for the microscope: its length, when full-grown, is about three quarters of an inch. When the time of its changes arrives, it forms for itself a small oval cell or case on a leaf of sedge or other

other convenient water-plant, and, after casting its skin, becomes a chrysalis: this change usually takes place in the month of August, and the complete insect emerges in that of September.

When these animals are congregated together in great multitudes on the surface of the water, which frequently happens in hot weather, they have been observed to diffuse a strong or disagreeable smell to a considerable distance. Like other water-beetles, they fly only by night. They deposit their eggs, which are very small, white, and of a somewhat cylindric form, on the stems of water-plants: they hatch in the space of about eight days, and immediately begin to swim about with much briskness in quest of prey.

BYRRHUS, THE BYRRHUS.

GENERIC characters, Antennæ longer than the head, clavate, with an oval knob, perfoliate; feelers subclavate; jaw and lip bifid. There are 13 species now known, which seem entirely confined to Europe, and most of them to Germany. Only two species are found in England, viz. the *pilula*, and the *varius*. They are principally distinguished from one another by the colour and figure of the elytra, or wing-cases. The body is ovate, convex or subglobular in some species, with the wing-shells covered by a short pile; the head, as in some genera lately noted, is retractile under the thorax. The larvæ of this tribe are extremely voracious, and much resemble those of the dermestæ. The byrrhus is likewise a great enemy to cabinets of preserved insects, upon the bodies of which it deposits its eggs, where the larvæ are first hatched, and then devour the carcase, leaving only the shell, within which it becomes a pupa, and finally goes off in its perfect state; when it begins to commit fresh depredations.

The

The ROUND BYRRHUS, *Byrrhus pilularius*.

Something larger than the common ladybird, *Coccinella septempunctata*; of an extremely convex shape, and, when disturbed, withdraws its head, and contracts its limbs, and lies in an inert state, resembling a seed or pill, whence the name *pilularius*. It is common on various plants and flowers. The ground colour is dark brown; but the under part of the abdomen appears almost white, owing to an infinite number of minute scales of that colour with which it is covered. The head is small, and often drawn in under the thorax, which is broad, covered with white and reddish scales, through which the black ground in some places appears. The elytra are bent in at the sides and under part of the body. They are covered with white and red scales, which form a kind of embroidered work. If rubbed, the small coloured scales come off, and the insect appears almost black.

The VARYING BYRRHUS, *Byrrhus varius*.

This is smaller than the preceding, its figure and form are however the same; only that the scales which cover the elytra are more numerous and closer set, so that the dark colour which constitutes the ground of the elytra, is no where to be seen. The thorax is brassy, and the striate minute scales have a greenish hue; but they are sometimes to be met with stripped of part of their scales, which renders them so different as not to be known for the same species, but appear spotted with black.

ANTHRENUS, THE ANTHRENUS.

GENERIC characters, Antennæ clavate, the club solid; feelers unequal, filiform; jaws membranaceous, linear, bifid; lip entire; head-retractile beneath the thorax. There are 13 species, mostly found among flowers; only one, the *muscoreum*, is found in books and museums.

The

The VARIEGATED ANTHRENUS, *Anthrenus varius*.

Body cinereous; the thorax and shells variegated with brown and cinereous. Inhabits Paris.

The BLACK-AND-YELLOW ANTHRENUS, *Anthrenus denticornis*.

Body and head black, thorax yellow at the edge, antennæ yellow, legs yellowish, shells black spotted with white; club elongated, ferrate. Inhabits the Island of Santa Cruz.

SILPHA, THE CARRION BEETLE.

GENERIC characters, Antennæ clavate, the club perfoliate; wing-sheaths margined; head prominent; thorax flattish, margined. This genus consists of 122 species, few of which are of any great beauty, and many are very small in size. Their usual abode is among decaying animal or vegetable substances, frequenting dung-hills, carrion, &c. and depositing their eggs chiefly in the latter. The larvæ are of a lengthened shape, and of an unpleasant appearance, being generally roughened with minute spines and protuberances.

The ENGLISH CARRION BEETLE, *Silpha vespillo*.

Wing-sheaths considerably shorter than the abdomen, or as if cut off at the tips: they are also each marked by two waved orange-coloured transverse bars, the rest of the insect being black. Length about three quarters of an inch. This insect seeks out some decaying animal substance in which it may deposit its eggs, and, in order to their greater security, contrives to bury it under ground. Three or four insects, working in concert, have been known to drag under the surface the body of so large an animal as a mole in the space of an hour, so that no trace of it has appeared above ground. The eggs deposited by

the parent insects are white, and of an oval or rather subcylindric shape: from these are hatched the larvæ, which, when full-grown, are more than an inch in length, and of a yellowish-white colour, with a scaly orange-coloured shield or bar across the middle of each division of the body. Each of these larvæ forms for itself an oval cell in the ground, in which it changes to a yellowish chrysalis, resembling that of a beetle; out of which, in the space of about eighteen days, proceeds the perfect insect. This species possesses a considerable degree of elegance, but generally diffuses a very strong and unpleasant smell: it flies with considerable strength and rapidity, and is generally seen on the wing during the hottest part of the day.

NITIDULA, THE NITIDULA.

GENERIC characters, Antennæ clavate, solid at the tip; wing-sheaths margined; head prominent; thorax margined and a little flattened. There are 43 species, a few of which inhabit South America; the rest are found on the continent of Europe.

THE FERRUGINOUS NITIDULA, *Nitidula ferruginea*.

Colour ferruginous; shape oval, subvillose, shells obscurely punctured, and striate; body beneath black, legs ferruginous; head brown. Inhabits England, on the lycoperdon.

OPATRUM, THE OPATRUM.

GENERIC characters, Antennæ moniliform, thicker towards the tip; head projecting from a cavity in the thorax; thorax a little flattened, margined; wing-sheaths immarginate, longer than the abdomen. There are 28 species, found chiefly among sand.

The

OF COLEOPTEROUS INSECTS. 107

THE CRENATE OPATRUM, *Opatrum crenata*.

Thorax crenate at the edge, and crenate striæ on the shells. Body and legs black; fore angle of the thorax projecting, hind one spinous. Inhabits Sweden, on sandy plains.

TRITOMA, THE TRITOMA.

GENERIC characters, Antennæ clavate, the club perfoliate; lip emarginate; anterior feelers hatchet-shaped; wing sheaths as long as the body. There are 10 species, chiefly inhabiting the fungi and bark of trees in Europe and India.

THE TWO-SPOTTED TRITOMA, *Tritoma bipustulata*.

Colour black, with a scarlet spot on each side at the base of the wing-sheaths, which are striated; and within the scarlet spot is a small brown dot. Thorax pointed behind; legs pale at the ends. Inhabits England, on tree-fungi.

CASSIDA, THE SHIELD BEETLE.

GENERIC characters, Antennæ moniliform, thickening towards the tip; the elytra have a broad margin, and the head is entirely concealed under the thorax, which is flat, and forms a kind of shield to it; a peculiarity from whence this genus takes its name; and the insect, when laid on its back, looks like a tortoise in miniature. There are 84 species; they have, in their larva state, two prongs, or lateral spines, projecting from the extremity of the abdomen, with which, and the bristle at the end of the tail, they form a kind of umbrella of their own excrements, to shelter them from the sun and rain. When the umbrella becomes unfit for that purpose, it exchanges it for another, which is fabricated of the same materials. These insects, which in their larva state are distinguished by manners as disgusting as

O 2

those

those of the Hottentots, are afterwards transformed into the most elegant of the beetle tribe. Before they undergo their last change, they cast the skin several times; their food all the while being different kinds of thistles, and verticillated plants.

The COMMON GREEN SHIELD-BEETLE, *Cassida viridis*.

This insect is often seen during the summer months in gardens, &c. especially on mint and other verticillate plants. Its length is nearly a quarter of an inch; its shape oval, and its colour bright green above, the body or under part being coal-black. The larva, which is of a highly singular appearance, is oval, of a yellowish brown colour, and has the body edged with a row or fringe of projecting fibres, the two terminal ones being much longer than the rest, and generally carried in an upright position while the animal is in motion. When ready for its change, it fastens itself to a leaf, and, casting its skin, commences chrysalis, which is also of a very unusual shape, and is remarkable for the breadth or dilatation of the fore-part. From the chrysalis, in the space of three weeks, proceeds the insect in its complete state. Inhabits Europe.

The LARGE SHIELD-BEETLE.

The largest of the genus: of a bright red colour, with the wing-shells thickly marked by small black spots on the middle part, and by strong, ramified, transverse black streaks on each side. Native of South-America.

COCCINELLA, THE LADYBIRD.

GENERIC characters, Antennæ subclavated, or a little thicker towards the end, the front of which is quite flat; the palpi are shaped like a club, the last articulation in form resembling a heart. The body

OF COLEOPTEROUS INSECTS. 109

is hemispherical; the thorax and elytra are margined; the abdomen flat. The species are reckoned 164 in number; but, as they intermix occasionally, it is extremely difficult to determine the real distinction of species from mere varieties. They are distributed into six divisions, according to the ground colour of their elytra.

The larvæ of this genus devour the aphides, and other small insects which infest and injure plants; wherefore they are often seen on the leaves of trees covered with the plant-louse. When the time arrives for their metamorphosis, they settle on a leaf by the hinder part of their body, then bend and swell themselves, forming a kind of hook. The skin extends, grows hard; and, in a fortnight's time, the chrysalis, or pupa, opens along the back. The insect in its perfect state receives the impressions of the air, that gives its elytra a greater degree of consistence. It seldom flies, and cannot keep long on the wing. Of all the different larvæ of the *coccinella*, the most curious is the *white hedgehog*, a name given it by M. de Reaumur on account of the singularity of its figure, and the tufts of hair which render it remarkable. It seeks its food on the leaves of trees. After a fortnight it settles in one spot, and, without parting with its fur, turns to a pupa or chrysalis; three weeks after which it becomes a *coccinella*. The slough appears unimpaired by its transformation. M. de Reaumur observed it on a plum-tree; and it is likewise found upon the rose-tree. When the *coccinellæ* first arrive at the state of perfection, the colours of their elytra are very pale, nearly bordering upon white or cream colour; and the elytra are very soft and tender, but soon grow hard, and change to very lively brilliant colours. Their eggs are of an oblong form, and of the colour of amber.

The

THE COMMON LADYBIRD, *Coccinella septempunctata*.

This species in particular is endeared to every one's recollection by irresistibly recalling the ideas of the playful amusements of infancy. The common or seven-spotted lady-bird, in the advanced state of spring, and the middle of summer, makes its appearance in every field and garden. It proceeds from a larva of a rather disagreeable appearance, of a lengthened oval shape, with a sharpened tail, of a black colour, varied with red and white specks, and of a rough surface: it resides on various plants, and changes to a short, blackish, oval chrysalis, spotted with red, and which gives birth to its beautiful inmate in the months of May and June.

THE EIGHTEEN-SPOTTED LADY-BIRD, *Coccinella*
18-punctata.

One of the most beautiful of the English species. It is little more than half the size of the common red kind, and is of a bright yellow colour, with numerous black specks, generally eighteen in number.

ALURNUS, THE ALURNUS.

GENERIC characters, Antennæ filiform, short; feelers four to six, very short; jaw horny, arched. There are only 3 species, inhabiting South America and India.

The LARGE ALURNUS, *Alurnus grossus*.

Feelers six; thorax scarlet, elytra yellow. The antennæ are black, half as long as the body; the thorax a little rough, pointed each side at the base, the hind margin black; scutellum rounded, and black; elytra larger and longer than the body, subpunctured; tarsi spongy beneath. Inhabits South America and India.—The other two species have but four feelers each.

CHRYSOMELA,

CHRYSOMELA, THE CHRYSOMELA.

From the variety of colours with which the insects of this tribe are adorned, they have been called *chrysomelæ*. There are no less than 341 different species described by naturalists, distinguishable by their size, colour, and manners. They all agree, however, in having the antennæ moniliform, and increasing in thickness towards the ends: the thorax is margined, the elytra not. This genus being so extremely extensive, some modern entomologists have subdivided it into several others.

Many of the *Chrysomelæ* are very nearly allied in point of habit or general appearance to the *Coccinellæ*, and have accordingly by different authors been arranged in either genus; but green and yellow are more predominant in these, as red as in the ladybirds. The species of the present genus are to be found almost every where, in woods, gardens, &c. Their progressive motion is slow; and some when caught emit an oily liquor of a disagreeable smell. The glittering colours with which several species of *chrysomelæ* are adorned, and which seem to exhibit the brilliancy of gold and copper, have occasioned their bearing that pompous name. The larvæ of these insects have in general an oval body, rather oblong and soft; on the fore-part of which are situated six feet, which are scaly, as is also the head. They prey upon the substance of leaves, rejecting the fibrous part. Those of the leaping *chrysomelæ* infest the cotyledons and tender leaves of plants. Of this genus is that very pernicious insect called by the country people the *turnip fly*, which infests turnips and many crops in the garden, destroying often whole fields while in their seedling leaves. In very hot summers they abound to an amazing degree, and make a pattering like rain, by jumping on the leaves of the turnips or cabbages.

The

The POPLAR CHRYSOMELA, *Chrysomela populi*.

A beautiful species, about twice the size of the common ladybird, and of a bright red colour, with the tips of the wing-shells black, and the thorax of a greenish or bluish black. It is found on the black and white poplars, willows, &c. and proceeds from a larva of nearly similar appearance to those of the genus *Coccinella*: it is of a pale yellowish green colour speckled with black, and edged with rows of small tubercles, those on the sides projecting in such a manner as to represent so many conical papillæ. Linnæus observes that this larva diffuses, on handling, a highly fetid, and even insupportable, smell. In general, on touching the larva, a small drop of white fluid instantly appears from a pore on the tip of each of the lateral tubercles, and after some time again disappears. It is this white fluid which diffuses the odour above-mentioned, and which is of so penetrating a nature, that, on handling the animal, the smell will often remain on the fingers throughout the whole day. Even when recently hatched, these larvæ possess the power of discharging the fetid fluid. In the month of June, the larva changes to a short brown chrysalis, so fastened as to hang by its extremity from the foot-stalk of a leaf or twig; and from this, in the space of a fortnight or less, proceeds the complete *Chrysomela*.

CRYPTOCEPHALUS, THE CRYPTOCEPHALUS.

GENERIC characters, Antennæ filiform: feelers four: thorax margined: shells, or wing-cases, immargined: body somewhat cylindrical. This genus has been lately erected out of several of the coleoptera tribes, but principally from the chrysomelæ of the twelfth edition of Linnæus: consisting of all such as have the head, as it were, drawn within the thorax,
(from

OF COLEOPTEROUS INSECTS. 113

(from *crypto*, to hide, *cephalus*, the head.) Gmelin enumerates no less than 299 species of this conformation, some or other of which inhabit almost every part of the world. Upwards of twenty species are found in England.

The LONG-LEGGED CRYPTOCEPHALUS, *Cryptocephalus longipes*.

Colour dusky black; elytra pale, with three black spots, one at the base, two in the middle, fore-legs long. The antennæ are short, serrate, and of a black colour. Inhabits Germany.

The NARROW CRYPTOCEPHALUS, *Cr. angustatus*:

Body oblong, narrow; thorax and elytra dull rufous, black in the middle. The head is black, the antennæ brown; legs ferruginous.

HISPA, THE PRICKLY BEETLE.

GENERIC characters, Antennæ cylindrical, approximate at the base, and seated between the eyes; feelers fusiform; thorax and elytra often spinous. This is an obscure genus, consisting of 25 species: the larva not known.

The BLACK PRICKLY BEETLE, *Hispa atra*.

Colour deep black; the upper part of the body entirely covered with strong spines, somewhat like the shell of a chesnut; the elytra are also set thick with vibriscæ, which makes this very small insect prove a hedgehog in miniature. It inhabits Europe, generally at the roots of long grass.

BRUCHUS, THE BRUCHUS.

GENERIC characters, Antennæ filiform, gradually thickening; head retracted and inflexed; elytra truncated, shorter than the abdomen. There are 27 species, small insects, but larger than the preceding genus.

The PEA-BRUCHUS, *Bruchus pisi*.

Elytra grey or black, with white spots, and a white fundament with two black spots. It is a native of North America, and destroys whole fields of pease; it is now found in several of the southern parts of Europe, where it does great injury to the corn.

PAUSUS, THE PAUSUS.

GENERIC characters, Antennæ of two joints, the upper very large, inflated, moveable, and hooked; head stretched forwards; elytra flexile, deflected, truncated.

This genus does not exist in the twelfth edition of the *Système Naturel*, but made its first appearance in a dissertation published at Upsal by Linnæus, in the year 1775. At that period only one species was known. In the year 1796, Dr. Adam Afzelius, then residing at the British settlement at Sierra Leona, discovered a second, and has described both with elaborate exactness in a paper on this genus published in the fourth volume of the *Transactions of the Linnean Society of London*. The etymology of the name Dr. Afzelius imagines to be from the Greek *παυσις*, signifying a pause, cessation, or rest: for Linnæus, now old and infirm, and sinking under the weight of age and labour, saw no probability of continuing any longer his career of glory; and so it in reality proved, at least with regards to insects; Pausus being the last he ever described. There are now five species.

The SMALL-HEADED PAUSUS, *Pausus microcephalus*.

The head is uncommonly small, and without horns; the thorax broader than the head, and very uneven, the two parts being entirely separated by a transverse furrow; the foremost division is elevated into a sharp ridge resembling a collar, and the hindmost is depressed.

OF COLEOPTEROUS INSECTS. 115

pressed or cut out in the middle into a cavity, which is obtuse behind, dilated and deepened before, and encompassed on the sides with diverging and outwardly declining lobes, being rounded at the top, and provided with shining hairs of a fulvous colour and bent inwards. The elytra are without dots, and rather longer than the abdomen: the under or real wings are sooty, and without the least glossiness. The abdomen has the terminal segment very retuse, and the margin of the next before it is visibly raised, the pivots of the antennæ are black, very bright, and at first sight might be easily taken for eyes; the under joint is furnished with a wart on the inner margin of the top, covered with papillary or cartilaginous hairs: the upper joint or clava is dotted, much larger than the head, and of the shape of an oblong spheroid, being rounded in front and compressed, with the carina raised into a sharp edge, provided on the vertex with four tubercles set in a row and tipped with hairs, and elongated behind into an obtuse tube, laterally compressed, above depressed and underneath having a knob, which, in moving, touches a bundle of hairs on the top of the under joint: the pedicle is long and crooked, its upper being broader, compressed, and keeled in front: the interior palpi are of a lanceolate-oblong shape, and furnished with very minute hinges: the mandibles have small hinges, and the inferior sheath is much larger than the superior. The hind-legs are a little shorter than the others: the joints of the tarsi are difficultly distinguished. This rare insect is a native of Banana island, and Sierra Leona in Africa. Its colour is a blackish brown.

The HORNED PAUSUS, *Pausus sphærocerus*.

Thus described by Dr. Afzelius. "I had been in Africa almost three years before I happened to meet with this remarkable little insect; and then it was quite accidentally. There was a house building

for the governor, on an eminence called Thornton Hill at the south end of Free-Town in Sierra Leona; and in the beginning of the year 1795, several apartments having been got ready, so as to be habitable, one of them was allotted to me, and I removed into it in the end of the month of January. I had not resided there many days, when one evening, having just lighted my candle and begun to write, I observed something dropping down from the ceiling before me upon the table; which, from its singular appearance, attracted by particular attention. It remained for a little while quite immoveable, as if stunned or frightened, but began soon to crawl very slowly and steadily. I then caught it, and, from the remembrance I had of the Linnæan species, I directly took it for a non-descript of this genus. Some few days after, coming into my room from supper, with a light in my hand, and having put it upon the table, there instantly fell another down from the ceiling. The third I was favoured with by the then governor, Mr. Dawes, who informed me that it had dropped down before him on the table, just when he had entered his room, and was going to write. The other three, which I afterwards collected, were also got upon similar occasions. and from thence I thought I had some reason to conclude that it is a nocturnal animal, that it becomes benumbed by candle-light, that it lives in wood, and prefers new-built houses, &c. After the end of February I never saw any more. The last which I caught I put into a box, and left confined there for a day or two. One evening, going to look at it, and happening to stand between the light and the box, so that my shadow fell upon the insect, I observed to my great astonishment, the globes of the antennæ, like two lanterns, spreading a dim phosphoric light. This singular phenomenon raised my curiosity, and, after having examined it several times that night, I resolved to repeat my researches

searches the following day. But the animal, being exhausted, died before the morning, and the light disappeared. And afterwards, not being able to find any more specimens, I was prevented from ascertaining the fact by reiterated experiments at different times; which I therefore must recommend to other naturalists who may have an opportunity of visiting Sierra Leona, requesting that they would particularly inquire into this curious circumstance.

“ I shall now only add some few remarks, shewing in what manner this new species differs from the old one. Not being quite so broad, it looks as if it were longer, and more cylindrical: it is also of a lighter or chestnut colour, and all over very glossy. The head is larger, but its annular base part smaller, and contracted: it is furnished with a little horn in the middle, between the eyes, which is strait, conic, and tipped with a tuft of cartilaginous hairs: the clypeus is only depressed, and the jugular triangle wider: the eyes are large, and very evident, those of the male black, though in a certain light appearing greenish; but those of the female are like pearls, or as if they were covered with a crystalline membrane: the angles of the brim of the socket are small and rounded at the top, and the hinder one lower than the eye. The pivots of the antennæ are not so discernible as in the former species, being like the surrounding parts in colour: the under joint is without any hairy papilla or wart: the upper joint or clava is of the size of the head, quite globular, and resembles an inflated bladder, being almost pellucid, and of a light flesh-colour: the keel is nothing more than a raised line, finishing on the vertex in only one chestnut-brown tubercle covered with cartilaginous hairs: behind there is a little conical shining hook, of the same colour and with the same sort of hairs bending outwardly, being of equal length with the horn on the head, but narrower: the pedicle is short, strait,

strait, and cylindrical. The interior palpi, furnished with very visible hinges, are a little thicker towards the top, but look in some directions as if they were filiform: the mandibles have large hinges, and the superior sheath almost as long as the inferior one, and nearly cylindrical. The thorax is of the same breadth with the head, and not very uneven, the two parts being separated by a furrow only on the sides and underneath, the foremost above and on the sides resembling an annular segment, and the hinder one impressed in the middle with a mark somewhat like two small diverging wings of a blackish silvery colour. The elytra are shorter than the abdomen, and minutely punctated: the under wings are of a shining and changeable violaceous colour, and not very dark: the abdomen has the terminal segment a little convex, and in the female more so than in the male: underneath, the third and last segments are darker than the others, the legs are all of equal length; the tarsi longer than those of the *Pausus microcephalus*, and have both the joints and the claws much more distinct." Linn. Trans. iv. 243.

ZYGIA, THE ZYGIA.

GENERIC characters, Antennæ moniliform, feelers equal, filiform. There is but one species.

The OBLONG ZYGIA, *Zygia oblongata*.

Colour rufous; head and elytra dull blue, thorax rounded, carinate; elytra rugged, obtuse, with three raised lines; legs unarmed, rufous.

ZONITIS, THE ZONITIS.

GENERIC characters, Antennæ testaceous; feelers four, filiform; jaw entire, longer than the feelers: There are eight species.

The

OF COLEOPTEROUS INSECTS. 119

The PALE ZONITIS, *Zonitis pallida*.

Colour of the body pale; antennæ and tips of the legs black; thorax unarmed; no spots on the elytra; eyes large, black. Inhabits the South American islands. It is called "large," but the size of none of the species is mentioned.

APALUS, THE APALUS.

GENERIC characters, Antennæ and feelers filiform; jaw horny, lip membranaceous, truncate, entire. There are but two species. 1. The *bimaculatus*, with a black dot on each side the elytra; it is black, and inhabits the sandy plains in the north of Europe. 2. The *quadrimaculatus*, with two black spots on each side on the elytra: this is rufous, and inhabits North America.

BRENTUS, THE BRENTUS.

GENERIC characters, Antennæ moniliform, inserted beyond the middle of the snout, which is very long, straight, and cylindrical. There are 11 species, classed in two divisions. I shall give a species from each.

The BEARDED BRENTUS, *Brentus barbicornis*.

Snout longer than the body, bearded beneath; antennæ shorter. Wing-cases elongate, clavate, black, with rufous spots. Eyes globular, black; thorax cylindrical, black, with grey hairs; legs black, with grey hairs, but not ferrated. Inhabits New Zealand.

The ANCHOR BRENTUS, *Brentus anchorago*.

Snout longer than the antennæ; wing-cases striate, with yellow dots. Body linear; thighs ferrated. This curious insect is commonly known by the name of the *long-necked weevil*, though the next genus commonly includes the weevils. Inhabits the East Indies.

CURCULIO,

CURCULIO, THE WEEVIL.

GENERIC characters, Antennæ clavate, resting upon the snout, which is prominent and horny; feelers four, filiform. Upwards of 700 species of this insect are now known; many of them exceeding in brilliancy and lustre all powers of description, principally distinguished by their colour.

The PALM WEEVIL, *Curculio palmarius*.

This is one of the largest of the exotic species. It is entirely of a black colour, and measures more than two inches in length from the tip of the snout to the end of the body. Its larva, which is very large, white, and of an oval shape, resides in the tenderest part of the smaller palm-trees, and is considered, when properly fried or broiled, as one of the greatest dainties in the West Indies. "The tree," says Madam Merian, "grows to the height of a man, and is cut off where it begins to be tender, is cooked like cauliflower, and tastes better than an artichoke. In the middle of these trees live innumerable quantities of worms, which at first are as small as a maggot in a nut, but afterwards grow to a very large size, and feed on the marrow of the tree. These worms are laid on the coals to roast, and are considered as a highly agreeable food."

The LONG-LEGGED WEEVIL, *Curculio longipes*.

The ground colour is a dark red brown; head the length of the thorax, terminating in a slender beak, three-fourths of an inch long; eyes black and oblong, almost surrounding the head; the antennæ are knobbed at their extremities, consisting of eight articulations, that next the head being nearly as long as all the rest; the thorax is marked longitudinally with four black stripes or bars; the escutcheon is very narrow and triangular; elytra marked longways, with several

several black narrow striae, and are shorter than the abdomen by almost three-eighths of an inch. All the legs are very long for the size of the insect; the fore-ones being more so proportionably than the rest; the shin joints are armed with sharp spines like hooks, those of the fore legs longer than the rest; the bearers consist of four articulations, besides the claws. It inhabits the Cape of Good Hope, and Madagascar. These three rank among the largest of the genus.

The GRANARY WEEVIL, *Curculio granarius*.

This is one of the minutest species of *Curculio*, at first hardly discernible without the help of a microscope. The larvæ of these are dreaded for the mischief they do in granaries, where they find means to introduce themselves into grains of corn, and there take up their abode. It is difficult to discover them, as they lie concealed within the grain. There they grow at leisure, enlarging their dwelling-place at the expence of the meal, on which they feed. Corn-lofts are often laid waste by these insects, whose numbers are sometimes so great as to destroy all the corn. When the insect is come to its full size, it remains within the grain, hidden under the empty husk, which subsists alone; and there transformed, it becomes a chrysalis; nor does it leave this abode till it becomes a perfect insect, making its way through the husk of the grain. It is no easy matter to discover by the eye the grains of corn thus hollowed out by these insects, as they outwardly appear large and full: but the condition the *curculio* has reduced them to, renders them much lighter; so that if corn, infested by these insects, be thrown into water, all the tainted grains will swim, and the good corn will sink to the bottom.

Other larvæ of *curculiones* are not so fond of corn, but fix on several other seeds. Beans, pease, and lentils, that are preserved dry, are liable to be per-

forated by these little animals, which prey upon the inward part of the grain, where they take up their habitation; and do not come forth till they have completed their transformation. Other species are lodged in the inside of plants. The heads of artichokes and thistles are often bored through, and eaten away, by the larvæ of large curculiones. Another small species pierces, and inwardly consumes, the leaves of elms. It frequently happens that almost all the leaves of an elm appear yellow, and as it were dead, towards one of their edges, while the whole remainder of the leaf is green. Upon inspecting those leaves, the dead part appears to form a kind of bag or small bladder. The two laminæ or outward pellicles of the leaf, as well above as below, are entire, but distant and separated from each other, whilst the parenchyma that lies between them has been consumed by several small larvæ of the curculio, that having been deposited there in the egg-state by the parent insect, have made themselves that dwelling. After their transformation they come forth, by piercing the bladder; and being is thus given to a curculio that is brown, small, and hard to catch, by reason of the nimbleness with which it leaps. This property of leaping depends on the shape and length of its hinder legs.

The NUT WEEVIL, *Curculio nucum*.

Though every one is well acquainted with the maggot in a nut, yet the various changes through which it passes, the mode of its introduction into the nut, and its appearance in its complete or perfect state, are what few that are not conversant in the history of insects have the least knowledge of.

The insect makes its appearance early in the month of August; and may then, be found creeping about hazel trees. The female insect, when ready to deposit her eggs, singles out a nut, which she pierces with her proboscis, and then, turning round, deposits
an

an egg in the cavity. She then passes on, and singles out another nut, which she pierces in the same manner, placing an egg in it, and thus proceeds till she has deposited in different nuts her whole stock. The nut, not apparently injured by this slight perforation, continues to grow, and gradually ripens its kernel. When the egg is hatched, the young larva or maggot, finding its food ready prepared, begins to feast on the kernel. By the time that it has arrived at its full growth, and has nearly consumed the whole of the kernel, the natural fall of the nut takes place: the inclosed larva, not in the least injured by the fall, continues in the nut some time longer, and then creeps out at the hole in the side, which it has previously made, by gnawing in a circular direction, and immediately begins to burrow or creep under the surface of the ground, till, having attained the depth sufficient for its convenient residence during the long period of its winter concealment, it lies dormant for eight months, and then, casting its skin, commences a chrysalis, of the same general shape and appearance with the rest of the beetle tribe; and it is not till the beginning of August that it arrives at its complete or ultimate form, at which period it casts off the skin of the chrysalis, creeps to the surface, and commences an inhabitant of the other world. During this state it breeds, and, like the major part of the insect race, enjoys for a short time the pleasures of a more enlarged existence. As a species it is distinguished by its brown colour, and the great length and slenderness of its curved snout: it measures nearly half an inch in length from the tip of the snout to that of the body.

The IMPERIAL WEEVIL, *Curculio imperialis*.

A scarce and elegant species, commonly called the diamond beetle. The head is black, and covered with a pile, or hairs, of a beautiful golden green, forming

two longitudinal black streaks, and three green ones: From this part proceeds a thick cylindrical beak, streaked with black and green; the eyes are black; the antennæ the same, and knobbed at their extremities; the thorax is golden green, with two broad longitudinal black lines on the top, and a narrow green one between them; the green colour being thickly beset with small black spots; the escutcheon is very small and green; the elytra or shells, next the thorax, are almost quadrangular, narrowing to their extremities, and of a golden green; formed by a great number of small round hollow punctures, or dents, which are less on the sides and extremities than the top, being regularly placed in grooves, so as to compose not less than eleven striæ, including the future, on each shell, that are black, and make a most beautiful contrast; the abdomen is green, with silvery rings; the legs black, covered with green hairs; thighs plain; the bearers consist of four articulations, besides the claws; the under part of them brown. Native of South America. This rich and curious insect, when placed under the microscope, dazzles the eye with more splendid refulgence and brilliancy than ten thousand diamonds set in gold.

The WINGLESS WEVIL, *Curculio apterus*.

The general colour is black; head short and round, terminating in a small narrow beak, almost the length of the thorax; in the middle of which are placed the antennæ, consisting of eight articulations; the first and last being long, the latter knobbed; eyes entirely surround the head, meeting at top and underneath; the thorax is round and rough; full of small warts or tubercles, discoverable only by a microscope; having a posterior margin; the escutcheon is small and triangular; the elytra are striated, full of small punctures or holes, and superbly decorated with red tubercles, which under the microscope have the lustre of vivid rubies;

OF COLEOPTEROUS INSECTS. 125

rubies; the thighs are smooth: the fore-shins are furnished with four teeth, the hinder ones with three; the bearers consist of four articulations, the first long, and the under part of them brown. Brought from India, the island of Madagascar, and the Cape of Good Hope.

RHINOMACER, THE RHINOMACER.

GENERIC characters, Antennæ setaceous, seated on the snout; feelers four, growing thicker towards the end, last joint truncate. There are only 3 species.

The WEEVIL RHINOMACER, *Rhinomacer curculioides*.

This, as its name imports, resembles the genus Curculio. Its colour is grey, with black antennæ and legs; the antennæ are as long as the thorax, but the last joint is sharp; the snout is flat, impressed in the middle. Inhabits Italy.

The second and third species belong probably either to the preceding genus or the following

ATTELABUS, THE ATTELABUS.

GENERIC characters, Antennæ moniliform, thicker towards the tip, seated on the snout; head pointed behind, inclined. This genus also resembles the numerous tribe of Curculiones, but the species are inferior in size and beauty. They have four wings, of which the superior are crustaceous, and serve as a sheath or cover to the inferior, which are membranous. Linnæus has 34 species, some of which have by later naturalists been otherwise arranged; but Dr. Turton, on the other hand, has increased the number to 59.

The HAZEL ATTELABUS, *Attelabus coryli*.

This is black, with red wing-sheaths. It usually measures about a quarter of an inch in length; and
is

is found chiefly among the leaves of the hazel-nut tree, which it rolls up into a cylinder closed at each end.—The *avellanæ*, or walnut attelabus, a distinct species in Linnæus, is considered by Dr. Turton as a variety only, the sole difference being that the thorax and legs are red.

The WEEVIL ATTELABUS, *Attelabus curculionoides*.

This has obtained its name from its resembling the Curculio. The antennæ are short, fixed on the point of the head, which is of a triangular shape, having the sharp angle joined to the thorax; the head, part of the thorax, and belly, are black; the rest of the insect is of a fine red. When running, it has a perpetual motion of its head from right to left.

The BIRCH ATTELABUS, *Attelabus betulæ*.

Entirely of a black colour, and remarkable for gnawing the leaves of the birch-tree, during the early part of spring, in such a manner that they appear notched on the edges. The thighs of the hind-legs in this insect are of a remarkably thickened form.

The BEE ATTELABUS, *Attelabus apiarius*.

This species has its name from the mischief which its larva occasionally commits among bee-hives, destroying the young of those insects. It is about three quarters of an inch in length, and of a beautiful violet-black, with red wing-shells, marked by three black transverse bands. The whole insect is also covered with fine short black hair. It is common in some parts of France, Germany, &c. Its larva above-mentioned is of a bright red colour.

NOTOXUS, THE NOTOXUS.

GENERIC characters, Antennæ filiform; feelers four, hatchet-shaped; jaw one-toothed; thorax a little

OF COLEOPTEROUS INSECTS. 127

little narrowed behind. Of this genus Linnæus enumerates four species; but Dr. Turton has 13.

The HOG NOTOXUS, *Notoxis porcarius*.

Colour black; elytra rough like a hog's back. Thorax cylindrical, pubescent; elytra flat, obtuse. Inhabits Van Diemen's Land.

The SOFT NOTOXUS, *Notoxus mollis*.

Body downy; elytra black, with three pale bands. Inhabits Europe, on flowers.

The UNICORN NOTOXUS, *Notoxus unicornis*.

Specific character, the thorax projecting like a horn over the head; a black band and dot on the elytra. Inhabits Europe, on umbelliferous plants. It is the Meloë monoceros of Linnæus and Donovan; but removed by Gmelin.

CERAMBYX, THE CAPRICORN BEETLE.

GENERIC characters, Antennæ setaceous; feelers four; thorax spinous or gibbous: wing-sheaths linear.

This is a very beautiful and finely variegated family, consisting of 466 species. The larvæ resemble soft oblong slender worms, with a scaly head and six hard legs on the fore-part; they bore through the inner part of trees, pulverising the wood, and are transformed into perfect insects in the cavities they make. Many of them diffuse a strong smell, perceivable at a great distance; and some, when taken, utter a sort of cry, produced by the friction of the thorax on the upper part of the abdomen and shells.

The LONG-LIMBED CERAMBYX, *Cerambyx longimanus*.

Length about three inches from head to tail. The wing-sheaths are beset with a very fine down, and are most elegantly varied with red, black, and yellow, in the
the

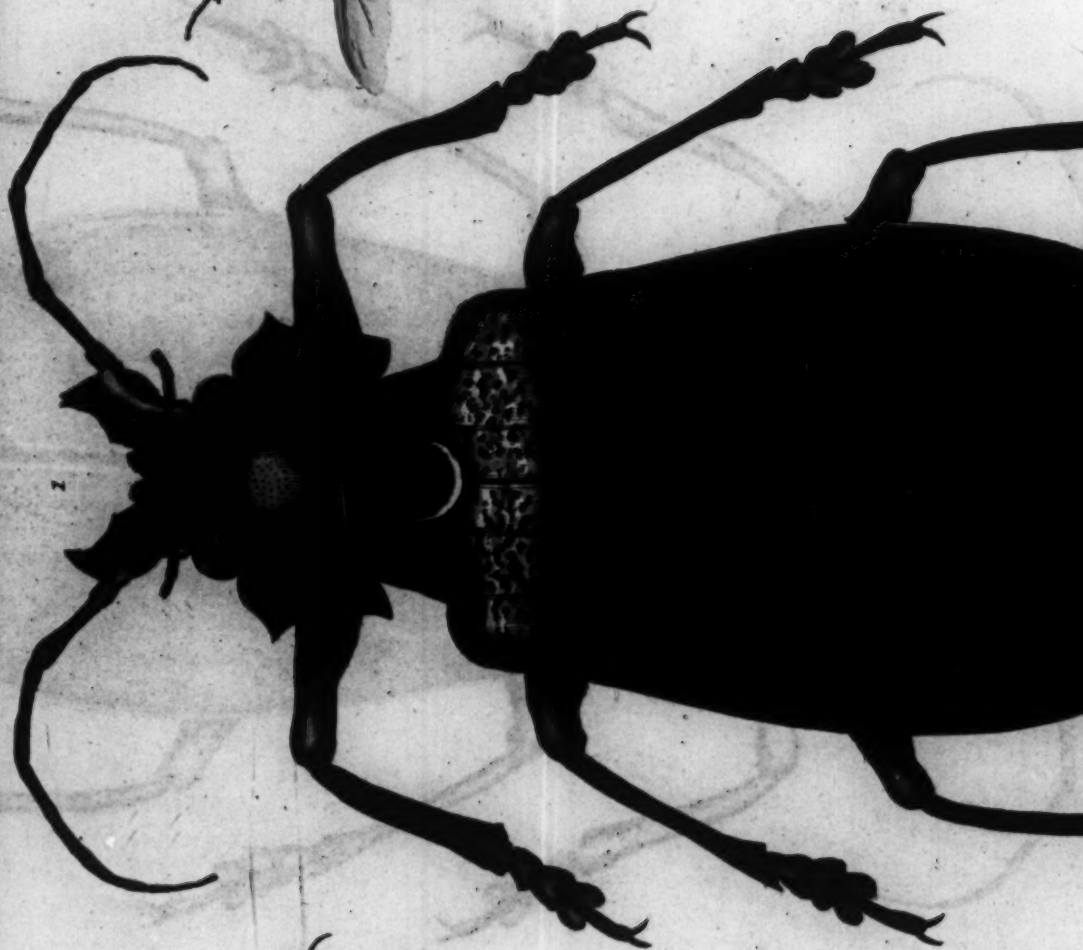
the form of stripes, disposed in various directions: the fore legs are of excessive length, very strong, and of a black colour, with broad red bars: the antennæ are long and black. This species is elegantly figured by Madam Merian in her celebrated work on the Insects of Surinam.

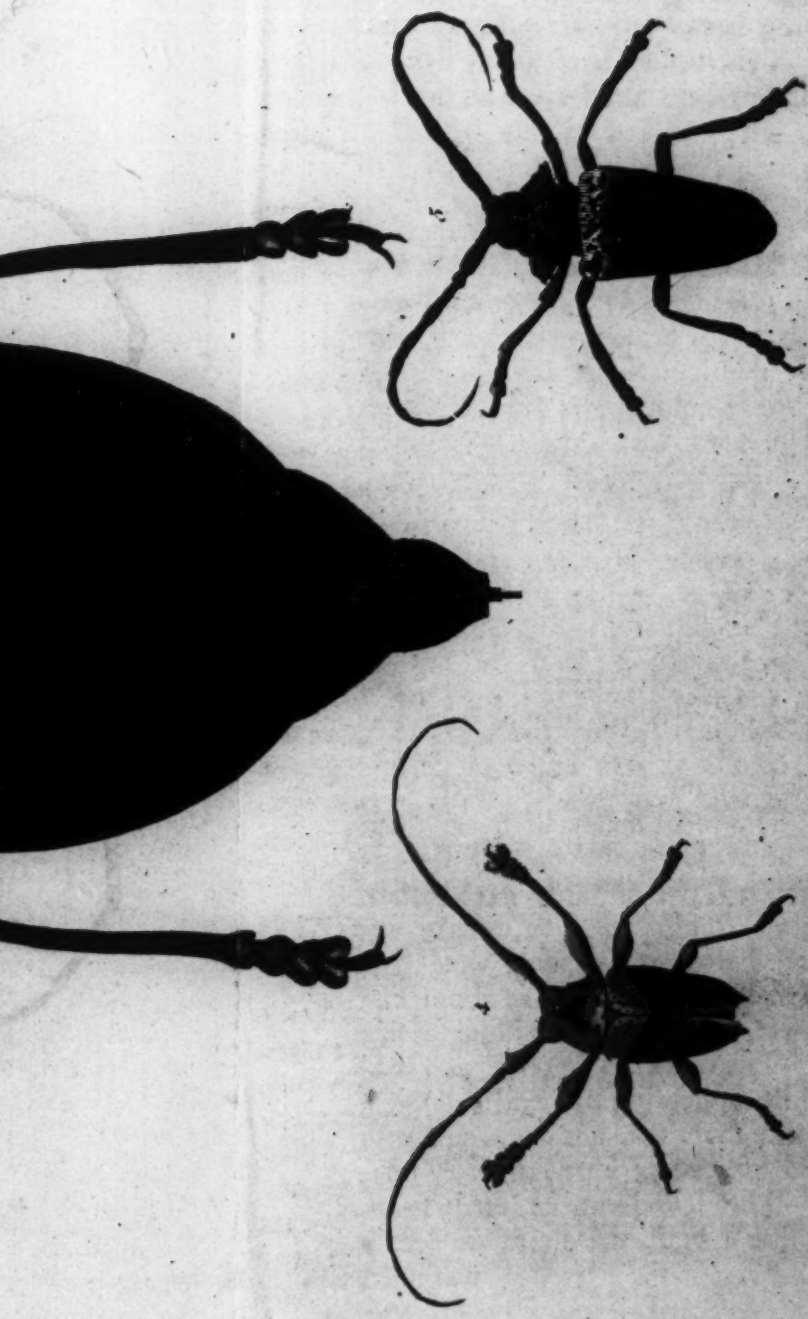
The LEATHERY CERAMBYX, *Cerambyx coriarius*.

This is also one of the larger European species, measuring near an inch and half in length, and is of a broadish shape, with thick ferrated antennæ of moderate length: the thorax is armed on each side with three sharp spines or denticulations, and the whole insect is of a deep brown colour. It proceeds from a large yellowish white larva, with a chesnut-coloured head, which resides in the hollows of decayed trees, and changes into a chrysalis of similar colour.

The GIGANTIC CERAMBYX, *Cerambyx giganteus*.

This curious species is shown at fig. 1. on the annexed Plate. The figure was taken of its natural size from the real insect, by Mr. Drury; it measured six inches and three-quarters in length, and was brought from Cayenne, in South America. The head and thorax are black; all the rest of the insect is a rich chesnut-brown, somewhat mealy in front. The jaws are placed in a horizontal position, with the extremities bending inward, or towards each other. The eyes are black, and so situated as to discern objects both above and below at the same time; the antennæ are thickest at their base, and are about half the length of the insect, gradually diminishing in size to their extremities. The thorax is smooth, and convex at top, the middle appearing like polished steel; the sides are rough, like shagreen, and are armed with three short or pointed spines like horns on each side; it is also margined. The scutellum, or escutcheon, is small and shaped like a bell; the elytra are deeply margined





The gigantic Cerambyx of Cayenne contrasted with the smaller species.

From the collection of the Hon. the Secretary of the Navy.

17th Nov. 1848

OF COLEOPTEROUS INSECTS. 129

margined on their sides and future, and have five longitudinal ribs with their surfaces rough like fish-skin. The under sides of the abdomen are covered with a dark brown pile, exactly like velvet. The legs are terminated with strong articulations and forked spines, which assist it in its passage over smooth surfaces, and in seizing or securing its prey.

The DEER-HORNED CERAMBYX, *Cerambyx damicornis*.

This also is one of the larger species, though very considerably inferior to the preceding: it is of a dark chestnut-colour, with very long curved jaws, spined or serrated on the inner side, as in those of the stag-beetle, or *Lucanus cervus*, to which this insect bears a considerable general resemblance. It is a native of many parts of America and the West-Indian islands; where its larva, like that of the palm-curculio, is in great request as an article of food, being considered by the transatlantic epicures as one of the greatest delicacies in the Western World. We are informed by authors of the highest respectability, that some people of fortune in the West-Indies keep negroes for the sole purpose of going into the woods in quest of these admired larvæ, and scooping them out of the trees in which they reside. Their general length is about three inches and a half, and their thickness that of the little finger. Dr. Browne, in his History of Jamaica, informs us that they are chiefly found in the plum and silk-cotton trees. They are commonly called by the name of *macaccos*, or *macokkos*. The mode of dressing them is first to open and wash them, and then carefully broil them over a charcoal fire.

The CINNAMON CERAMBYX, *Cerambyx moschatus*.

A somewhat smaller species, and entirely of a pale ferruginous brown colour: the thorax is marked on each side by two spines, and the wing-shells are each tip-

ped by a very small projecting point. It is a native of South-America.

The MUSK CERAMBYX, *Cerambyx moschatus*.

So named from its powerful scent, which however is far more agreeable than that of the substance from which it takes its name, resembling rather the combined scent of roses, musk, and ambergris. So diffusive is this agreeable odour, that, whenever the insect makes its appearance, which is commonly in the hottest part of July, it may be smelt to a considerable distance, and if taken and rolled up for some minutes in a handkerchief, will perfume it for the whole day. This insect, which is not very uncommon in many parts of our own country, measures about an inch and quarter in length, from the head to the end of the body: its colour is a fine dark green, with a slight gilded tinge on the upper parts, and sometimes it varies in having a strong cast of blue or purple: the antennæ are rather shorter than the body. It is chiefly found on willows and poplars, in the decayed wood of which its larva resides. It has been found that the *Cerambyx moschatus*, when dried and reduced to powder, and made use of as a vesicatory, in the manner of the officinal cantharides, produces a similar effect, and in as short a space of time.

The LONG-HORNED CERAMBYX, *Cerambyx ædilis*.

One of the smaller or middle-sized species. It is a native of many parts of Europe, and is found in our own country, though not a very common insect. It is of a grey colour, with two or three obscure transverse brown bands, and the thorax is marked by four yellow spots. It is remarkable for the excessive length of its antennæ, which, in the male especially, are five or six times that of the body. It is found in old decayed timber, and in the trunks of trees.

The

The PIMPLED CERAMBYX, *Cerambyx pustulatus*.

Colour black; thorax cylindrical, with a fulvous spot in the middle. Inhabits Austria; found likewise in Jamaica. See the Plate, fig. 4.

The PORTER CERAMBYX, *Cerambyx bajulus*.

Thorax villous, with two tubercles; body brown, the female paler. Inhabits Europe. See the Plate, fig. 2.

Fig. 3 on the Plate is the *Cerambyx meridianus*, or Southern Cerambyx, a native of England. Fig. 5. *Cerambyx verrucosus*, the Warty Cerambyx, a very beautiful species, native of the Barbadoes.

CALOPUS, THE CALOPUS.

THIS genus consist of three species, two of which were left by Linnæus in the genus Cerambyx; and the third, from De Geer, was noted by him as a Cerambyx also. The generic characters, as stated by Gmelin, are—Antennæ filiform; feelers four, the fore ones clavate, the hind ones filiform; thorax gibbous; wing-veins linear. Colour brown.

The SERRATE-HORNED CALOPUS, *Calopus ferraticornis*.

Antennæ compressed, serrate before. The thorax is unarmed, and partly oval. The body is of a long cylindrical shape. Inhabits Europe.

The SMALL CALOPUS, *Calopus pigmæus*.

Antennæ serrate, and hairy. Inhabits Sweden; size of a flea. De Geer, vol. v. Pl. 4. fig. 5.

LEPTURA, THE WOOD BEETLE.

GENERIC characters, Antennæ setaceous; feelers four, filiform; wing-sheaths tapering towards the tip; thorax slender, rounded. This genus is also allied to

the Cerambyx, and contains 125 species, some of which are of considerable beauty. The larvæ of the wood-beetles are found, like those of the Cerambyx, in the perforated trunks of trees, and, like them, they devour the pulverised wood when digging their retreat.

The WATER LEPTURA, *Leptura aquatica*.

So named from its being particularly found in the neighbourhood of waters, frequenting the plants which grow near the water's edge. It is about half an inch in length, and of a golden green colour, sometimes varying into copper-colour, purple, or blue, and is distinguished by having a tooth or process on the thighs of the hind-legs, and five such ferratures on the legs themselves. Lip entire. Inhabits Europe.

The NOON WOOD-BEETLE, *Leptura meridiana*.

One of the larger European species, often measuring an inch in length, and is a very common insect during the decline of summer in fields and woods, generally appearing in the hottest parts of the day. It is of a dull brown colour above, sometimes yellowish-chestnut; and beneath is of a brilliant tawny yellow, shining with the lustre of satin. Lip bifid. It has very much the general appearance of a Cerambyx, and might perhaps with equal propriety be referred to either genus.

NECYDALIS, THE CARRION-EATER.

GENERIC characters, Antennæ setaceous or filiform; feelers four, filiform; wing-sheaths less than the wings, and either shorter or narrower than the abdomen: tail simple. The thorax is narrow and rounded; the body of a lengthened shape. There are 39 species, which have obtained their English name from their supposed predilection for carrion. In their winged state, they generally frequent the woods;

OF COLEOPTEROUS INSECTS. 133

woods; their residence and habits, while larvæ, are wholly unknown.

The LARGER CARRION-EATER, *Necydalis major*.

Distinguished by its large and prominent eyes. The antennæ are raised upright as far as the first articulation, after which they are bent, and turned aside. Head black; wings longer than the body.

The SMALLER CARRION-EATER, *Necydalis minor*.

A common insect in fields and about hedges in the summer months, and has somewhat of the habit of a small *Cerambyx*, but the wing-sheaths are but half the length of the body, and are grey-brown, each marked at the tip with a linear white spot, the rest of the insect being black. Its length is rather more than a quarter of an inch.

The BLUE CARRION-EATER, *Necydalis cærulea*.

A beautiful species. It is about half an inch in length, and entirely of a bright blue colour, sometimes greenish blue: the wing-sheaths are of the length of the body, but narrow, so as not to cover the sides of the wings; and the hind-thighs are very thick. It is found in woods during the summer months.

LAMPYRIS, THE GLOW-WORM.

GENERIC characters, Antennæ filiform; wing-sheaths flexible; thorax flat, semiorbicular, concealing and surrounding the head; abdomen with the sides plaited into papillæ. The female (in most species) wingless.

The COMMON GLOW-WORM, *Lampyris noctiluca*.

This is a highly curious and interesting animal. It is seen during the summer months, from June till the close of August, if the season be mild, on dry banks about woods, pastures, and hedgeways, exhibiting,

biting, as soon as the dusk of the evening commences, the most vivid and beautiful phosphoric splendour, in form of a round spot of considerable size. The animal itself, which is the female insect, measures about three quarters of an inch in length, and is of a dull earthy brown colour on the upper parts, and beneath more or less tinged with rose-colour, with the two or three last joints of the body of a pale or whitish sulphur-colour. It is from these parts that the phosphoric light above-mentioned proceeds, which is of a yellow colour, with a very slight cast of green. The body, exclusive of the thorax, consists of ten joints or divisions. The larva, pupa, and complete female insect, scarcely differ perceptibly from each other in general appearance, but the phosphoric light is strongest in the complete animal.

The glow-worm is a slow moving insect, and in its manner of walking frequently seems to drag itself on by starts or slight efforts as it were. The male is smaller than the female, and is provided both with wings and wing-sheaths: it is but rarely seen, and it seems, even at present, not very clearly determined whether it be luminous or not. The general idea among naturalists has been that it is not, and that the splendour exhibited by the female in this species is ordained for the purpose of attracting the male; and accordingly she can withdraw or display this light at pleasure, by contracting or unfolding her body. When crushed with the hand, this luminous substance of the glow-worm adheres to it, and continues to shine till it is dried up. But the insect may be kept alive, if properly supplied with moist turf, grass, moss, &c. for a considerable length of time; and, as soon as the evening commences, will regularly exhibit its beautiful effulgence, illuminating every object within a small space around it, and sometimes the light is so vivid; as to be perceived through the box in which it is kept. This insect deposits its eggs, which

OF COLEOPTEROUS INSECTS. 135

which are small and yellowish, on the leaves of grass, &c.

The ITALIAN GLOW-WORM, *Lampyris Italica*.

In this species it is said that the male as well as the female is luminous. It seems to be a native of our island also, though less common here than in the warmer parts of Europe. Aldrovandus describes the *winged glow worm* as having its wing-shells of a dusky colour, and at the end of the body two brilliant fiery spots like the flame of sulphur. And in the Philosophical Transactions for the year 1684 we find a paper by a Mr. Waller, describing the *English flying glow-worm* as of a dark colour, with the tail part very luminous: he maintains that both male and female of this species are winged, and that the female is larger than the male. The light of this insect was very vivid, so as to be plainly perceived even when a candle was in the room. Mr. Waller observed this species at Northaw in Hertfordshire. From the figure given by this writer it appears to be about half an inch in length, which is much smaller than the common female glow-worm.

In Italy this flying glow-worm is extremely plentiful; and we are informed by Dr. Smith, and other travellers, that it is a very common practice for the ladies to flick them by way of ornament in different parts of their head-dress during the evening hours.

HORIA, THE HORIA.

GENERIC characters, Antennæ moniliform; feelers four, thickening towards the tip; lip linear, rounded at the end. Of this there are only two species, one of which was placed by Linnæus in the genus *Cantharis*; so that this genus seems to have been established by Gmelin.

The

The TRANQUEBAR HORIA, *Horia testacea*.

Colour rufous; antennæ and legs black. Body large and cylindrical; in the male the hind thighs are thicker, and toothed. Inhabits Tranquebar.

The EUROPEAN HORIA, *Horia dermestoides*.

Resembles the Dermestes, but by Linnæus noted as a Cantharis. It is testaceous; the eyes, wings, and breast, black. Inhabits Europe.

CUCUJUS, THE CUCUJUS.

GENERIC characters, Antennæ filiform; feelers four, equal, the last joint truncate and thicker; lip short, bifid; the divisions linear and distant: body depressed. Gmelin enumerates only eleven species; to which Dr. Turton has added two. They inhabit every quarter of the globe, though they are seldom seen, being mostly in rotten wood. This genus was originally formed by Professor Fabricius. The name, however, is not new; it had been already applied by Geoffroy to the Buprestes; and it has been used to designate a sort of Indian insect which shines in the night like a glow-worm. It is difficult to distinguish the generic characters of the Cucujus without the help of a good microscope.

The FLAT CUCUJUS, *Cucujus depressus*.

Length six or seven lines, but so compressed as to be hardly one line in thickness. The head, corselet, and elytra, are blood red; the anterior part of the belly is red in the middle between the hind legs, but the sides and the five last rings are black; as are the eyes, lip, points of the mandibles, the antennæ, and legs, except the last articulation of the tarsus. The head is thick, flat, triangular like a shovel, broader backwards than the corselet. The eyes are quite at the sides. The antennæ are much before them, and
rough;

OF COLEOPTEROUS INSECTS. 137

rough; the first articulation is the largest, the second the smallest, the last oval and pointed; they are all hairy. There are some dents in the lip. The neck is raised, and narrower than the corselet, which is flat, orbicular, and marked with four small furrows, and so obscurely ferrated as not to be visible to the naked eye. The elytra are much compressed, of equal size, and appearing smooth to the eye, but under the microscope a grain like that of leather is discovered. The future is raised; the outer rims double or channelled. The escutcheon is small and rounded. The thighs are thickish; the tarsus has four articulations, ending in a double claw. This insect being continually under the bark of trees, it is to be presumed that its larva, hitherto unknown, is destructive to wood.

The BLUE CUCUJUS, *Cucujus cæruleus*.

This differs from the preceding in being somewhat raised or rounded on the upper surface, though it is still much compressed. Length from four to six lines, thickness less than a line. Found under the bark of the willow-tree. The blue colour of the elytra, whence the name, has often a purple cast. The head is black, much protruded, and on a right line with the body; it narrows a little behind the eyes, which are black; the throat and corselet are black also; the belly dark orange. Of the other species very little is known.

CANTHARIS, THE CANTHARIS.

GENERIC characters, Antennæ filiform; feelers fetaceous; thorax marginated, and shorter than the head; elytra, or wing-cases, flexile; and the sides of the belly plated and papillous. Linnæus enumerated twenty-seven species of the cantharis, but they are now increased to 101; most of them to be found in different parts of Europe. The cantharis used in making blistering plasters is ranked under a different genus, viz. the LYTTA.

THE BROWN CANTHARIS, *Cantharis fusca*.

Of a dull brown or blackish cast, with the thorax red, having a black central spot. These insects are of a very voracious nature, and are often observed to prey even on their own species.

THE BIPUSTULATED CANTHARIS, *Cantharis bipustulata*.

A beautiful insect, considerably smaller than the preceding, and of a more slender or cylindric shape: its colour is a very dark but elegant gilded green, with the tips of the wing-shells red, and on each side the thorax, a little below the setting on of the wing-shells, is a triple vesicle, of a bright red colour, extensile or retractile at the pleasure of the insect, and which, if accurately observed by the microscope, will generally be found to exhibit an alternate inflation and contraction, resembling that of the lungs in the larger animals. This species is found during the middle of summer on various plants, and particularly on nettles.

SERROPALPUS, THE SERROPALPUS.

GENERIC characters, Antennæ setaceous, feelers four, unequal; the anterior ones longer, deeply ferrate, (whence the name,) composed of four joints, the last of which is very large and truncate; the posterior ones subclavate: thorax margined, concealing the head; with a prominent angle on each side: head deflected; feet formed for digging. This genus consists of only two species, both described in the Stockholm Transactions for 1786; one of them was placed by Linnæus and Fabricius in the genus *Elater*.

THE STRIATED SERROPALPUS, *Serropalpus striatus*.

Body brown; shells striate. Inhabits the island of Runsale, where it is found in old wooden buildings in the evenings in autumn.

The

The SMOOTH SERROPALPUS, *Serropalpus lævigatus*.

Body black, shells striate. Inhabits Europe.—*Elater buprestoides*, Linn. and Fabr.

ELATER, THE SKIPPER.

GENERIC characters, Antennæ of some setaceous, of others filiform, pectinated, or serrated. Their larvæ live in decayed trunks of trees, where they undergo their metamorphoses. Many of the coleopterous insects have a great difficulty in restoring themselves when laid on the back; the apparatus with which the insects of this genus are provided for that purpose, is singular and curious. An elastic spring, or spine, projects from the hinder extremity of the breast, and there is a groove or cavity in the anterior part of the abdomen. When laid on its back, the insect raises and sustains itself on the anterior part of the head and the extremity of the body, by which means the spine is removed from the groove where it is lodged, when in its natural position; then suddenly bending its body, the spine is struck with force, across a small ridge or elevation, into the cavity from whence it was withdrawn; by which shock, the parts of the body before sustained in the air are so forcibly beat against whatever the insect is laid on, as to cause it to spring or rebound to a considerable distance. The antennæ are lodged in a cavity scooped out of the under side of the head and thorax, probably to preserve them, when the insect falls, after its singular leap.

There are no less than 183 species of this genus of insects now ascertained; of which twenty-six are found in England. They are all easily distinguished from every other genus by the spine at the extremity of the thorax; a character which scarcely any other insect possesses. The *phosphoreus*, the *noctilucus*, and several other species of this insect, give out a strong phosphoric light in the night time, the streams of

which are so luminous, that a person may see to read the smallest print, by placing them on the leaf of a book.

The FAN-HORNED SKIPPER, *Elater flabellicornis*.

Specific character, antennæ with a fan-shaped tuft of eight large black leaves; body brown. This is the largest of the genus yet known; measuring about two inches and a half from the head to the anus. The head is small, and of a squarish form, surrounded with a small black margin, having four palpi, two of them very short: the eyes are brown and shining; the antennæ are the length of the thorax, and black; those of the male are pectinated, or rather laminated, having not less than eight distinct plates or laminæ lying close to each other, which, when closed together, appear to be of equal thickness. The general colour of the insect is a dark shining bronze: the thorax has a black margin, terminating on the sides in two sharp spines; the escutcheon is small; the wing-cases or shells are smooth and glossy, without any margin, and rounding at their extremities, without any spines; the elastic spring is black, and small for the size of the insect. All the under part of the insect is the same colour as the upper; the bearers or feet consist of five articulations, besides the hooks or claws. It is a native of India, and of Sierra Leona on the coast of Africa.

The SHINING SKIPPER, *Elater noctilucus*.

Specific character, a glabrous yellow spot on each side of the thorax. This remarkable insect is called in South-America, where it is not uncommon, *cocujas*. It is about an inch and a half long, and of a brown colour, with the thorax marked on each side by a smooth yellow semitransparent spot: these spots, like those on the abdomen of the glow-worm, are highly luminous, diffusing, during the night, so brilliant a phosphoric

OF COLEOPTEROUS INSECTS. 141

phosphoric splendor, that a person may with great ease read the smallest print by the insect's light, if held between the fingers and moved along the lines : but if eight or ten be put into a clear phial, they will afford a light equal to that of a common candle. It is said that the inhabitants of Hispaniola, &c. before the first arrival of the Spaniards, made use of no other light than these insects ; and we are informed by Mouffet, that when Sir Thomas Cavendish, and Sir Robert Dudley son to the Earl of Leicester, first landed in the West-Indies, and saw, the same evening, an infinite number of moving lights in the woods, they supposed that the Spaniards were advanced upon them unawares, and immediately betook themselves to their ships. To this story the reader will give the credit he thinks it deserves.

The RUSTY SKIPPER, *Elater ferrugineus*.

Of the British species this is one of the largest, measuring about three quarters of an inch, and, as its name imports, of a ferruginous or reddish-brown colour ; but the hind part of the thorax is bordered with black : it is found in fields, among grass, in the month of June.

The FURROWED SKIPPER, *Elater porcarius*.

Wing-cases with villous furrows, or grooves ; colour brassy-green. A beautiful species, and large, measuring an inch and three quarters. The head is a dark brassy green ; the eyes brown and shining ; the antennæ black, consisting of ten articulations ; the thorax on the sides is yellow, having a broad bar of a green colour running longitudinally from the head to the hinder part, being marginated with black ; the wing-cases are deeply furrowed with green and yellowish lines, the sides having a broad yellow stripe all round them, and are marginated with black ; the extremities rounded, and not ending in a spine ; the breast,

breast, abdomen, and legs, are entirely dark green; the elastic spring is black and large; the bearers consist of five articulations besides the hooks. It inhabits South America.

The TESSELLATED SKIPPER, *Elater tessellatus*.

Size of the rusty skipper. Colour brown, with a slight coppery tinge, and scattered over with fine ash-coloured pile, in such a manner as to appear tessellated, or marked into minute squarish divisions. It is not uncommon in fields during the middle of summer. The larvæ of these insects are of a slender form, and devour the roots of the grasses, &c.

The BANDED SKIPPER, *Elater fasciatus*.

Undulated white bands on the wing-cases. This species is about three quarters of an inch in length. The head is grey; the eyes black; the antennæ serrated and black, much shorter than the thorax, which is grey, with two small round black spots on the middle, and two square ones next the escutcheon; the escutcheon itself is black, surrounded by a patch of the same colour. The wing-cases are grey, with two waved irregular bands crossing them, one near the middle, the other near the anus: all the under part of the insect is black; and, when viewed through a microscope, appears to be powdered, as it were, with grey. The legs are entirely black. Native of Africa and Europe; and found likewise in England.

The DARK SKIPPER, *Elater obscurus*.

Mostly of a dull black; inhabits Europe. That destructive insect called the *wire-worm* is said to be the larva of this species.

The SERRATED SKIPPER, *Elater ferraticornis*.

Antennæ serrate, and shorter than the thorax; head reddish-brown. The eyes are small and black; the antennæ

OF COLEOPTEROUS INSECTS. 143

næ black ; the thorax red-brown, with a dark longitudinal dagger-shaped streak running along the middle from the head to the escutcheon ; the sides terminating in two angular points ; the escutcheon is small and brown. The wing-cases are reddish, brown, margined, and ending in two spines ; they are a little striated, with three longitudinal streaks of a dark brown colour ; the principal one in the middle along the suture, the others on each side ; the breast and fore-part of the abdomen is the same red brown colour as on the upper side ; the hinder part of the abdomen is darker, having two remarkable oval spots of a lightish colour near the anus ; the bearers consist of no more than four articulations besides the hooks. Inhabits Rio Janeiro in the Brasils : it is also found in Italy. Length an inch and a quarter.

The GOLDEN SKIPPER, *Elater auratus*.

Ranked among the most elegant of the elateres, measuring near an inch and three-fourths. The head is green, the eyes black ; the antennæ black, and shorter than the thorax, having at each joint some short hairs, plainly to be discovered when viewed through a microscope. The thorax is green, and margined, appearing as if finely polished ; the hinder corners being pointed, and forming obtuse angles ; the escutcheon is round, and shining. The wing-cases are likewise green, variegated with shades of yellow and gold, shining, and margined ; their extremities terminating in two sharp points. All the under part of the insect is of the same shining green as the upper, except the bearers, which are black, and consist of five articulations besides the claws. In this insect the elastic spring is very large and strong, so that it can jump to a considerable height. Inhabits China.

The ANGULATED SKIPPER, *Elater angulatus*:

Size of the preceding. The head and eyes are black,

black, the former being furnished with two remarkable thick and short horns or spines; the antennæ are black, and strongly pectinated, consisting of not less than ten articulations; the thorax is orange coloured, with a broad black streak down the middle. Two remarkable black lozenge-shaped spots are placed near the middle of the thorax, and are united to the longitudinal black streak. Close to these are two singular swellings, like protuberances, on the sides of the thorax. The escutcheon is black; the wing-cases pale orange, the sides and middle having three black stripes running along them, the extremities ending in two sharp spines; the breast is orange, with two long black spots on the sides; the abdomen is of a dark cream-colour, with two black stripes running along the sides from the breast, and joining at the anus; all the legs are orange; the bearers consisting of five articulations, besides the hooks. Native of the Brasils. Described and figured, with sixteen other species, in the *Encyclopædia Londinensis*, vol. vi.

The PAINTED SKIPPER, *Elater pictus*.

Length three quarters of an inch. The head is yellow-brown; the eyes small and black; the antennæ deeply serrated, and black, being shorter than the thorax; the thorax is yellow-brown, with several black longitudinal streaks; the escutcheon is very small, and yellow-brown; the wing-cases the same colour, with several faint black marks thereon, particularly two situated near the middle, of a triangular shape, and reaching to the sides; they are a little striated, and terminate at the anus in four blunt spines, two to each. All the under part of this insect is of a grey colour. The elastic spring in this insect is remarkably large. Native of Africa. From the *Ency. Lond.*

CICINDELA,

CICINDELA, THE SPARKLER.

GENERIC characters, Antennæ setaceous; feelers six, filiform, the hind ones hairy; jaws prominent, and furnished with teeth; eyes a little prominent; breast roundish and marginated. There are 60 species at present known.

The insects belonging to this genus are in general very beautiful, and merit the attention of the curious in their microscopic observations; some are minute, though not inferior in splendor, therefore best suited for that amusement. Living objects are ever preferable to dead ones. The larvæ of all this genus live under ground; and are, as well as the perfect insects, tigers in their nature, attacking and destroying all they can overcome.

The FIELD SPARKLER, *Cicindela campestris*.

Specific character, six white dots on the wing-shells. This is a beautiful species. The upper part of the body is of a fine gold-green colour, rough, and rather bluish. The under side, as also the legs and antennæ, are of shot-colour, gold and red, of a copperish cast. The eyes are very prominent, and give the head a broad appearance. The thorax is angular, and narrower than the head; which constitutes the character of the cicindela. It is rough, and of a green colour tinged with gold, as well as the head. The elytra are delicately and irregularly dotted: each of them has six white spots, viz. one on the top of the elytrum, at its outward angle: three more along the outward edge, of which the middlemost forms a kind of lunula: a fifth on the middle of the elytra, opposite the lunula; and that one is broader, and tolerably round: lastly, a sixth at the extremity of the elytra. There is also sometimes seen a black spot on the middle of each elytrum, opposite to the second white spot. The upper lip is also white, as is the upper

side of the jaws, which are very prominent and sharp. This insect runs with great swiftness, and flies easily. It is found in dry sandy places, especially in the beginning of spring. In the same places its larva is met with, which resembles a long, soft, whitish worm, armed with six legs, and a brown scaly head. It makes a perpendicular round hole in the ground, and keeps its head at the entrance of the hole to catch the insects that fall into it; a spot of ground is sometimes entirely perforated in this manner.

The SYLVAN SPARKLER, *Cicindela sylvatica*.

Specific character, two dots and a white waved band on the wing-cases. This is of a dark or blackish purple. It frequents woods, and is far less common than the former.

BUPRESTIS, THE COW-BURNER.

GENERIC characters, Antennæ filiform, serrate, as long as the thorax; feelers four, filiform, the last joint obtuse or truncate. The head is half drawn back within the thorax, and the antennæ are serrated: the mouth is armed with jaws, and furnished with palpi: the elytra are margined and cover the abdomen, and the tarsi have five articulations: the feet are saltatorii. There are 160 species of this insect now known, most of them natives of the Indies. The French have given the name of *Richard* to this genus, on account of the beautiful colours, with which most of the species are adorned; but with us they are called the *cow-burner*, because, being of the nature of cantharides, they endanger the life of cattle if they eat any of them in their food.

These insects are not common in England. They are of the richest splendour; and some appear, when alive, to be united in colour with the resplendent particles of emeralds, rubies, diamonds, and gold. Applied to the microscope, the splendour is so great as

to

OF COLEOPTEROUS INSECTS. 147

to dazzle the eye. The whole body is green and gold, with a bluish cast underneath: but what distinguishes it, are four dents or depressed spots that are seen upon the elytra, two upon each. One of these dots is on the outward rim of the elytrum, about the middle of it, near the abdomen, and is the larger one. The other is on the inner edge, close to the suture, about three-fourths of that suture downwards, and exactly opposite its fellow on the other elytrum. This latter one is the smaller. The whole upper part of the insect, viewed through a glass, appears finely dotted.

The LARGE BUPRESTIS, *Buprestis gigantea*.

Specific character, wing-cases two-toothed, rugged; thorax smooth; body finely burnished. This is the largest species hitherto discovered, measuring two inches and a half in length: the thorax is smooth, resembling the colour of polished bell-metal, and the wing-sheaths are of a gilded copper-colour, with a cast of blue-green, and are wrinkled in a longitudinal direction with slight prominent ramifications. It is a native of India, China, and many other parts of Asia; and is also found in South-America. The large size, metallic colours, and wrinkled surface of the wing-shells, in this insect, have induced the Chinese to attempt imitations of it in bronze, in which they succeed so well that the copy may be sometimes mistaken for the reality. This fine insect proceeds from a large white larva, much resembling that of the *Lucanus cervus*, or great stag-chaffer, and which feeds, according to Madam Merian, who has figured it in her celebrated work on the Insects of Surinam, on the roots of plants of the *Convolvulus* tribe.

The STRIPED BUPRESTIS, *Buprestis vittata*.

A species of a bright gold-green colour, with a broad band of the most brilliant reddish gold-colour running down each of the wing-sheaths. Native of India.

The STERN-HORNED BUPRESTIS, *Buprestis sternicornis*.

Smaller than the former species, and of a thicker shape. It is of the most brilliant golden-green colour, marked with numerous impressed points, which are sometimes whitish: the thorax is still brighter, marked above by numerous impressed points, and stretched out beneath into a conical process. It is a native of India.

The RED BUPRESTIS, *Buprestis chrysis*.

So much allied to the *sternicornis* in shape and size, that it has by some been considered rather as a variety than truly distinct; it differs however materially in the colour of the wing-sheaths, which are of the richest reddish chesnut brown, while the thorax, as in the former, is of a brilliant gold-colour, with a cast of green. It is a native of India.

THE YELLOW BUPRESTIS, *Buprestis fascicularis*.

Wing-cases entire, striate, with tufted hairy dots; body hairy. This inhabits Africa. Its colours are not very brilliant. Linnæus gave it the name of *fascicularis*, "bearing bundles," because the elytra, as far as the head, are ornamented with numerous tufts, pointed, and standing upright, in one part yellow, and in another orange. These insects are said to be sometimes found in timber-yards.

The RUSTIC BUPRESTIS, *Buprestis rustica*.

This is a British species, and one of the largest of those that inhabit Europe, measuring about half an inch in length, or rather more. It is of a coppery colour, with several longitudinal furrows along the wing-shells, the thorax being of a deep blue-green, with numerous impressed points: it is found in woods.

The

The TWO-SPOTTED BUPRESTIS, *Buprestis bimaculata*.

Specific character, wing-cases entire, striate, with a red spot upon each; body brown green. This is a native of Asia, and one of the most beautiful of the kind. The prevailing colour is a deep green with a lustre of gold, on which may be seen here and there some large spots of gold and purple. The middle of the elytra is adorned with two large spots, round, yellow, and transparent, which by their colour approach to gold. On each side of these spots, that is, above and below them, on both sides of the upper part of the body, and straight against the forehead, are seen purple and gold. The eyes are large, black, and brilliant. The antennæ are black, and composed of small beads. The wings are brown and transparent. The under-part of this insect is so richly gilded, that under the microscope it appears as if covered with a sheet of gold beset with rubies and diamonds. The breast, and the four rings of the belly, are adorned with purple and green, intermixed with a lively splendour of gold. The six feet, two of which are protruded from the farthest extremity of the breast, and four near the neck, are of a deep gilded green. The wings are purple within, and have a green border.

HYDROPHILUS, THE WATER-LOVER.

GENERIC characters, Antennæ clavate, the club perfoliate; feelers four, filiform; hind legs formed for swimming, being fringed or finned on the inner side.

This genus differs from that of *Dytiscus* only in the structure of the antennæ, which, instead of being setaceous, are short, and furnished with a clavated and perfoliated tip or knob. Both are inhabitants of ponds and stagnant waters, where they swim with much velocity, turning round with great dexterity. They are extremely voracious, and destructive to the
more

more tender aquatic insects, worms, and young fish, which they ravenously seize with their forked jaws, and destroy by sucking out their juices. It may be added that the Hydrophili, like the Dytisci, sometimes emerge from the waters, and fly about the fields, and thus migrate occasionally from water to water; but as this happens chiefly by night, it is not generally observed. The genus Hydrophilus, like that of Dytiscus, has been greatly increased by the persevering researches of modern entomologists. Dr. Turton enumerates 31 species.

The WATER-CLOCK, *Hydrophilus piceus*.

Perhaps the largest of the British Coleoptera, if we except the *Lucanus cervus*; measuring nearly an inch and half in length. It is entirely black, and of a smooth surface, and is particularly distinguished by the form of its thorax, which is produced beneath into a very long and sharp-pointed spine, stretching to a considerable distance down the abdomen: the hind-legs are furnished on each side with strong, but very fine, hairs, as in the Dytisci, which the animal resembles in its manners. It is a native of stagnant waters, where its larva is principally observed to prey on the smaller kind of water-snails, and is distinguished by a particularity in the highest degree remarkable: this consists in the apparently anomalous situation of the legs, which seem, unless very accurately considered, to be placed, not beneath the thorax, as in other insects, but on the upper part, and from thence to be deflected towards the sides. This uncommon appearance however is not owing to a real dorsal insertion of the legs, but principally to the peculiar shape and position of the head; and the deception is so much heightened by the inverted posture in which the insect generally swims and rests, that it is by no means easy, even for the most scientific observer, to divest himself of the erroneous idea before-mentioned.

Frisch,

OF COLEOPTEROUS INSECTS. 151

Frisch, in his History of Insects, appears to have been completely convinced of the reality of the dorsal insertion of the legs; and the celebrated Reaumur, having discovered something similar in another aquatic insect, was so struck with the unusual appearance, that he has commemorated it as a circumstance unparalleled in the animal world. The author of the fourth volume of Seba's Thesaurus was of the same opinion; and expressly warns his readers, that his engraver, thinking to rectify what he supposed an erroneous drawing, has represented the legs in this larva as situated beneath the thorax, and not on the upper part. The sagacious Lyonet, in his observations on Lefler's *Theologie des Insectes*, seems to have been the first who detected the common error, and ascertained the real structure of the animal, which he has clearly and satisfactorily explained.

The larvæ are supposed to remain about two years before they change into pupæ or chrysalides. When the larva is arrived at its full growth, it secretes itself in the bank of the water it inhabits, and, having formed a convenient cavity or cell, lies dormant for some time, after which it divests itself of its skin, and appears in the form of a chrysalis, in which state having continued for some time longer, it again delivers itself from its exuviae, and appears in its complete or beetle form. When first disengaged from the skin of the chrysalis, it is of a pale colour, and very tender; but in the space of a few hours the elytra or wing-cases acquire a degree of strength and colour, which gradually grows more and more intense, till the animal, finding itself sufficiently strong, comes forth from its retreat, and commits itself in its new form to the waters.

The male is distinguished from the female by the structure of the fore-legs, which, as in the genus *Dytiscus*, are furnished, near the setting on of the feet, with a sort of horny concave flap or shield;
the

the legs of the females being destitute of this part. The structure of the hind-legs is finely calculated for the animal's aquatic mode of life, being furnished on the inside with a series of close-set filaments, so as to give a sort of finny appearance to the legs, and to enable the animal to swim with the greatest ease and celerity. It may be added, that the female of the *Hydrophilus piceus* affords an example of a faculty which seems to be exercised by no other coleopterous insect; viz. that of spinning a kind of web or flatish circular case of silk, which it leaves floating on the water, and in which it deposits its eggs. This case is terminated on its upper surface by a lengthened conical process resembling a horn, of a brown colour, and of a much stronger or denser nature than the case itself, which is white. The young larvæ, as soon as hatched, make their escape from the envelopment of the case, and commit themselves to the water. This curious particular in the history of the *Hydrophilus piceus* was first discovered by Lyonet.

The CARABUS WATER-LOVER, *Hydrophilus caraboides*.

Measures about three quarters of an inch in length, and is of a polished black colour, and of an oval shape. Like the former, it inhabits stagnant waters, where its highly curious larva, admirably figured in the works of Roesel, may not unfrequently be found; it is fringed along the sides with numbers of separate plumes, or feather-formed branchiæ.

DYTISCUS, THE DIVER.

THE divers have obtained their name from the sudden escape they make from danger by plunging into water. They are sometimes called *water-beetles*. The antennæ are slender and setaceous; they have six filiform palpi or feelers; the hind feet are hairy, and formed for swimming; and are also furnished with

OF COLEOPTEROUS INSECTS. 153

with claws; the under side of the fore feet of the males is hemispherical; the elytra of the female are mostly furrowed.

From the indefatigable research of modern entomologists, no less than 147 species are now ascertained, distinguished chiefly by their antennæ, the colour of the elytra, &c. The larvæ are often met with in water; they are oblong, and have six scaly feet; their body consists of eleven segments; the head is large, with four filiform antennæ, and a strong pair of jaws; the last segments of their body have rows of hairs on the sides; and the abdomen is terminated by two spines charged with the like hairs, forming a kind of plumes. These larvæ are frequently of a greenish variegated brown: they are lively, active, and extremely voracious: they devour and feed upon other water-insects, and often tear and destroy each other. The perfect insect is little inferior to its larvæ in voraciousness, but it can only exercise its cruelty on the larvæ; the perfect insects, like himself, being sheltered by the kind of scaly cuirass with which they are armed. This creature must be touched cautiously; for, besides its power of giving a severe gripe with its jaws, it has, under the thorax, another weapon, a long sharp spine, which it will drive into one's fingers by the effort it makes to move backward. The eggs of the dytiscus are rather large, and are inclosed in a kind of silky dusky bag, of a strong and thick texture, in form round, and terminated by a long appendix or slender tail, of the same substance. These bags are often found in the water, and from them are brought forth the eggs and larvæ of the insect. Many species of the perfect insect are commonly seen in stagnant waters, which they quit in the evening to fly about. They swim with incredible agility, making use of their hinder legs after the fashion of bars. The elytra of the females are in general furrowed, and those of the male plain: when they first arrive at their perfect

state, their elytra are almost transparent, and in many species of a beautiful dun or fire colour, mingled with shades of a greenish brown, or punctulated, or banded, grooved, or striated. The males in general resemble the Dermestides, the females the Carabi.

The MARGINED DIVER, *Dytiscus marginalis*.

Colour above shining raven grey, except the outward edge of the thorax and elytra, and the fore part of the head, which has a transverse streak or band of a dun colour, situate on the upper lip; the under part of the body is a mixture of yellow and brown. The elytra are exceeding smooth and glassy, with obscure spots or lines, forming two longitudinal bands on the edge of each of the elytra. The sternum underneath is forked and blunt. The legs have no other articulation than that which resembles a hinge. The four anterior feet are singularly shaped in the males; the four first articulations of the tarsi are very short and broad, with brushes underneath, which form a round scoop, with which the insect lays hold of his female. The last joint of those tarsi is long, and bears the nails. The hinder feet have their tarsi flat, bearded, shaped like fins, and the claws of those feet are straight and nowise hooked. The antennæ and palpi are dun coloured. This ranks among the largest of the species. The female has the elytra substriated and brown, and black at the ends.

This insect is not uncommon in stagnant waters, where its larva also resides, which is of a very extraordinary shape, and so utterly unlike the animal into which it is at length transformed, that no one conversant in the history of insects would suppose it to have the most distant relationship to it; since it much more resembles the insects of the shrimp tribe, and by the older writers, as Mouffet, Aldrovandus, &c. has actually been referred to that tribe of animals,
under

under the title of *Squilla aquatica*. It measures, when full-grown, about two inches and a half in length, and is of a pale yellowish brown colour, with a high degree of transparency: the head is very large, somewhat flattened, and furnished in front with a pair of very strong curved forceps, which, when magnified, appear to be perforated at the tips by an oblong hole or slit, through which the animal sucks the juices of its prey: the legs are slender, of moderate length, and placed on each side the thorax, the abdomen being lengthened out to a very considerable extent, and finely fringed or ciliated on each side the tail, which terminates in a most elegantly divided fin or process. This larva is of a bold and ferocious disposition, committing great ravages, not only among the weaker kind of water insects, as well as water-newts, tadpoles, &c. but even among fishes, of which it frequently destroys great numbers in a season, and is therefore justly considered as one of the most mischievous animals that can infest a fish-pond. A larva of this kind has been known to seize on a young tench of three inches in length, and to kill it in the space of about a minute; and even the banstickle itself, which is so great a destroyer of the small fry of fishes, and so well armed for defence, is notwithstanding a prey to this devouring insect, which seizes it with violence, and very quickly destroys it. When arrived at its full growth, the larva betakes itself to the banks of the water it inhabits, and forming itself an oval hollow in the soft earth or clay, in a few days changes into a chrysalis much resembling that of the genus *Scarabæus*, and of a whitish colour. From this, in the space of about three weeks, proceeds the complete insect.

The ASH-COLOURED DIVER, *Dytiscus cinereus*.

A much smaller species, and of a broader shape in proportion: the male is of a blackish olive-colour,

with an ochre-coloured band across the thorax, which, as well as the smooth wing-shells, is edged with ochre-colour, while the female has those parts of a dull ash-colour, strongly marked by several longitudinal furrows. The larva of this species is of the same general form with that of the preceding, but proportionally smaller, and with a longer neck. It is not uncommon in stagnant waters.

CARABUS, THE GROUND BEETLE.

GENERIC characters, Antennæ setaceous, or rather filiform: feelers mostly six, the last joint obtuse and truncate; thorax and wing-cases margined.

In this family, which contains no less than 360 species, are found some of the largest of the British insects. In their winged state, the heads of these animals are prominent; their mouths, like those of the preceding genus, are armed with jaws and teeth. Their eggs are deposited under ground, or in decayed trees, where the larvæ reside till they are metamorphosed. It is during their caterpillar state, that they are prejudicial to gardens; and hence have been ironically called *gardeners* by the French. It is not, however, vegetable productions alone that they devour: they are the greatest tyrants to other insects, and destroy indiscriminately, as many as their strength enables them to overcome. They are very active.

The BLUE CARABUS, *Carabus violaceus*.

This species is of an oblong shape; the colour a dark violet: the edges of the thorax and elytra are violet with a shade of purple; the latter have neither dots nor streaks, but are marked with strong longitudinal wrinkles. It is found among rotten wood, in this country; wingless.

The GARDEN CARABUS, *Carabus hortensis*.

This is the species most frequently seen in gardens
and

and pathways. It is about an inch in length, and of a dark brassy-green colour, with the wing-shells obscurely marked by three longitudinal rows of impressed points, while the edges are often of a shining purple or violet-colour. Wingless.

The BOMBARDIER, *Carabus crepitans*.

This remarkable species is winged; breast, head, and legs, ferruginous or iron-coloured, and the elytra black. It keeps itself concealed among stones, and seems to make little use of its wings: when it moves, it is by a sort of jump; and whenever it is touched, one is surprised to hear a noise resembling the discharge of a musket in miniature, during which a blue smoke may be perceived to proceed from its anus. The insect may be made at any time to play off its artillery, by scratching its back with a needle. If we may believe Rolander, who first made these observations, it can give twenty discharges successively. A bladder placed near the anus is the *arsenal* whence it derives its store, and this is its chief defence against an enemy, although the smoke emitted seems to be altogether inoffensive, except it be by causing a fright, or concealing its course. Its chief enemy is another species of the same genus, but four times larger: when pursued and fatigued, the bombardier has recourse to this stratagem, by lying down in the path of the large carabus, which advances with open mouth and claws to seize it; but, on this discharge of the artillery, suddenly draws back, and remains a while confused: during which the bombardier conceals himself in some neighbouring crevice; but, if not happy enough to find one, the large carabus returns to the attack, takes the insect by the head, and tears it off. From some late observations it appears, that some exotic species of this genus have a similar power in a still higher degree, being of a much greater size than the European insect.

TENEBRIO,

TENEBRIO, THE DARKLING:

GENERIC characters, Antennæ moniliform, with the last joint rounded. Thorax plano-convex, margined. Head exerted. Wing-sheaths stiffish.

These insects are commonly of a dark sombre colour: some have wings under the elytra, while others are apterous. The genus contains 89 different species. The larvæ of some reside among rotten sticks, or rubbish; those of others take up their abode among flour, and different kinds of food. After they have become perfect insects, they enter houses and devour every sort of provision. Their principal resort is to damp cellars, where putrid air and darkness attract them. It is from their precipitately avoiding light, as well as their gloomy appearance, that they derive their generic name.

The OBLONG DARKLING, *Tenebrio molitor*.

An insect often seen in houses: it is one of the smaller kinds, and is coal-black, of a lengthened shape, with longitudinally striated wing-shells, and proceeds from a larva commonly known by the name of the *Meal-Worm*, from its being so frequently found in flour, &c. it is of a yellowish white colour, about an inch long, slender-bodied, and of a highly polished surface, and is considered as the favourite food of the nightingale when kept in a state of captivity: it is said to remain two years before it changes into a chrysalis.

The ROUND DARKLING, *Tenebrio globosus*.

This species is seen during the hottest part of the summer about walls and pathways, and is distinguished by the remarkably-globular appearance of the body. It is totally black, the under parts having sometimes a slight violaceous cast, and the joints of the feet, which are remarkably broad, are of a dull brown.

The

OF COLEOPTEROUS INSECTS. 159

The whole insect is of a very smooth, but not polished, surface, and usually measures about three quarters of an inch in length: in this however it varies considerably, some specimens, probably the males, being considerably smaller: the antennæ in this insect are beautifully moniliform, all the joints being globular.

PIMELIA, THE PIMELIA.

GENERIC characters, Antennæ filiform, feelers four; thorax plano-convex, margined; head exerted; wing-cases stiffish, wings usually none. This genus, which greatly resembles the preceding, and seems to have been formed out of it, consists of 117 species. The only species we shall describe was placed by Linnæus among the Tenebriones, where it is retained by Dr. Shaw.

The OMINOUS PIMELIA, *Pimelia mortifaga*.

This inoffensive animal is regarded by the common people of Sweden as a presage of death, if seen to crawl about the house. It is generally, however, found in dark neglected places, as beneath boards, in cellars, &c. It is a coal-black insect measuring about an inch in length, of rather slow motion, and distinguished by the remarkably pointed appearance of the wing-sheaths, which at their extremities project a little beyond the abdomen: they are also perfectly connate or undivided, forming a complete covering to the body, and being carried over the sides to some distance beneath, and the insect is totally destitute of real or under wings. Inhabits Europe. If handled, and especially if crushed, diffuses a highly unpleasant smell.

MANTICORA, THE MANTICORA.

GENERIC characters, Antennæ filiform, the joints cylindrical;

cylindrical; feelers four, filiform: thorax rounded before, emarginate behind: head projecting: mandibles exerted: shells united: wings none. There is but one species.

The SNOUTED MANTICORA; *Manticora maxillofa*.

Body black; head subglobular, impressed each side; mandibles toothed at the inner base. Thorax impressed in the middle, elevated behind, the margin rounded and notched at the tip. Shells above flat, rough, deflected at the edge, with a very sharp lateral ferrate line: legs simple black. Inhabits the Cape.

ERODIUS, THE ERODIUS.

GENERIC characters, Antennæ moniliform; feelers four, filiform: body roundish, gibbous, immarginate: thorax transverse: wing-cases closely united, longer than the abdomen: jaw horny, bifid; lip emarginate.—There are only four species of this insect at present known; and these, from their shape, have been confounded with the Coccinellæ and Chrysomelæ.

The TORTOISE ERODIUS, *Erodium testudinarius*.

Wing-cases united, rough; the sides covered with whitish dust. The thorax is widely emarginated for the reception of the head. The species are all black. This inhabits the Cape of Good Hope; two others are found in Arabia; and the *minutus*, which has the wing-cases quite smooth, inhabits the East Indies.

LYTTA, THE LYTTA.

THIS genus includes many of the species placed by Linnæus under that of Meloë, and by others among the Cantharides, particularly the famous blister-insect. GENERIC characters, Antennæ filiform; feelers four, unequal, the hind-ones clavate: thorax roundish: head inflected, gibbous: wing-shells soft, flexile,

as the abdomen. There are 32 species, of which we shall notice only

The BLISTER-INSECT, OR SPANISH FLY, *Lytta vesicatorius*.

This is an insect of great beauty, being entirely of the richest gilded grass-green, with black antennæ. Its shape is lengthened, and the abdomen, which is pointed, extends somewhat beyond the wing-sheaths: its usual length is about an inch. This celebrated insect, the cantharis of the materia medica, forms, as is well known, the safest and most efficacious epispastic or blister-plaster, raising, after the space of a few hours, the cuticle, and causing a plentiful serous discharge from the skin. It is supposed however that the *cantharis* of Dioscorides, or that used by the ancients for the same purpose, was a different species, viz. the *Meloe cichorei* of Linnæus, an insect of a black colour, with three transverse yellow bands on the wing-shells. These insects were formerly brought only from Spain, whence they were called Spanish flies; but they are met with in France, Italy, and some parts of Germany, and even of England. In the southern parts of Europe it multiplies exceedingly; some of the provinces of Spain annually receive a large sum for those they export to the rest of Europe. They are there seen flying in vast swarms, and alighting upon trees and shrubs, whose leaves they devour. They are said to prefer the ash leaf to that of any tree in the forest; but whatever leaves they devour, they are uniformly accompanied with a heavy nauseous smell, like that of mice, and thence their haunts are discovered by those who go in quest of them. In their humid and living state, the odour exhaled from these insects is so corrosive and irritating, that the gathering them is attended with danger. In that occupation, the labourers, who imprudently collect them in the heat of the day, and with their hands uncovered, are

VOL. XIII. No. 168. X frequently

frequently seized with a violent heat of urine, and voiding of blood. The same accidents befall those who unwarily sleep under the trees they frequent.

The female seems to feel the access of amorous desire in a more violent degree than the male: it is she that courts the male; and, in the great act of fecundation, it is she that occupies that place to which in most animals nature directs the other sex. After impregnation, she deposits her eggs in the ground, where they remain till they have undergone the various changes that are to bring them forth winged flies.

When collected and dried, these insects become so light, that fifty of them hardly weigh a dram: it is in that state they are grinded down into the well-known powder, which constitutes the basis of the common blistering plaster.

As a medicine, it has been thought that they peculiarly affect the kidneys and urinary passages, proving diuretic; though whether they affect the former it is much doubted, if we can believe the evidence of Dr. C. Smith, and Dr. Cullen, notwithstanding Werlhof gives a remarkable instance of the diuretic powers of cantharides; and tells us, he had frequently experienced the same in dropsy and other diseases. He gave a grain of the powder in a dose, and repeated this every four hours, and it was only after the third dose, after a suppression of urine of many days standing, that it began to yield. Externally they are caustic, and are used for blisters. They produce a more plentiful discharge of serum than any of the vegetable acids. They also destroy fungous flesh. Internally, their efficacy is truly valuable, when skilfully managed. The case where their internal use is most necessary, and most safe, is, when they are wanted to scour the urinary passages, and this is when they are obstructed with sloughs, and such viscidities as are apt to be washed off from the ulcerated parts; this happens mostly in women. In venereal cases, where much
filth

OF COLEOPTEROUS INSECTS. 163

filth hath fallen on the genitals, the tincture is very useful. They are recommended in gravel, leprosy, the fluor albus, ulcers in the bladder, uterus, and kidneys. The phlegmatic may take them without much caution, but the hot and bilious require them mixed with proper correctors. Their use in cutaneous disorders has sometimes been successful. In cases of stone in the kidneys, fits of gravel, stone in the bladder, some œdematous cases, and sometimes in pregnant women, their use is not to be admitted. However used, they are apt to produce a stranguary, and inflammation of the urinary passages; to prevent which, when blisters are applied, requires the assistance of nitre, oily drinks, soap pills, &c. Washing the blistered part, when dressed, with warm milk, greatly relieves these symptoms. When imprudently taken into the stomach, they cause great heat, inflammation, bloody urine, a dribbling, heat, and priapism, thirst, and a cadaverous breath, &c. in which cases give nitre, camphor, mucilage of gum arabic, and acids; simple oxymel is of excellent use as an antidote. Sometimes blisters laid to the thighs, or calves of the legs, have produced a gangrene, because a flux of humours is very easily invited to these parts; therefore, should not be applied to them when they are œdematous, but rather to the inside of the arms, wrists, nape of the neck, or head.

Proof spirit, or a mixture of equal parts of water and strong ardent spirit, extracts by digestion, a tincture from cantharides which possesses all the virtues of the insects themselves. When this tincture is distilled, the spirit which comes over has the smell of the cantharides. Strong ardent spirit takes up the caustic part only; whence it follows that the intensity of the tincture may be varied, as well by varying the strength as the quantity of the spirit to a given dose of the insects. This tincture has the character of warming and increasing the circulation of the parts

to which it may be applied in rheumatic pains, sciatica, the wandering gout, &c. For exciting amorous desires in women, and increasing lust in men, both tincture and powder have been improvidently used, to the great injury of the human constitution.

MELOE, THE BLOSSOM-EATER.

GENERIC characters, Antennæ moniliform, the last joint ovate; thorax rounded; head inflected, gibbous; wing-cases soft, flexile.

In the first edition of the System of Nature, there was only one species of this genus taken notice of; in the later improvements of that celebrated work, there are thirty-six kinds of these animals enumerated; while, perhaps, a still greater number remains to engage the researches of future historians. The insects of this genus are either winged or apterous; in the former, the elytra are short, extending about half the length of the abdomen; in the latter, these parts reach the whole length of the body, and conceal under them two slender wings. In all of them the antennæ resemble a necklace, composed of a number of small rings; those of the middle larger than those near either extremity.

The OIL BEETLE, *Meloe proscarabæus*.

Near an inch and half in length. Colour violet-black, especially on the antennæ and limbs. The wing-sheaths are very short, in the female insect especially, scarcely covering more than a third of the body, and are of an oval shape; but this insect has no wings. This species is frequent in the advanced state of spring in fields and pastures, creeping slowly, the body appearing so swollen or distended with eggs as to cause the insect to move with difficulty. On being handled, it suddenly exudes from the joints of its legs, as well as from some parts of the body, several small drops of a clear deep-yellow oil or fluid,
of

OF COLEOPTEROUS INSECTS. 165

of a very peculiar and penetrating smell. This oil or fluid has been highly celebrated for its supposed efficacy in rheumatic pains, &c. when used as an embrocation on the parts affected: for this purpose also the oil expressed from the whole insect has been used with equal success.

The female of this species deposits her eggs, which are very small, and of an orange colour, in a large heap or mass beneath the surface of the ground: each egg, when viewed by the microscope, appears of a cylindric shape, with rounded ends: from these are hatched the larvæ, which, at their first appearance, scarcely measure a line in length, and are of an ochre-yellow, with black eyes: they are furnished with short antennæ, six legs of moderate length, and a long, jointed, tapering, body, terminated by two forking filaments or processes. These larvæ are found to live by attaching themselves to other insects and absorbing their juices. They are sometimes seen strongly fastened to common flies, &c. a practice so extraordinary as to have caused considerable doubt whether they could possibly have been the real larvæ of the *Meloe proscarabæus*. The accurate observations of Degeer however have completely proved that they immediately fasten themselves to any insect, whether living or dead, that is placed near them. It is therefore probable that in their natural subterraneous state they attach themselves in a similar manner to the larvæ of the larger beetles, worms, &c. &c.

MORDELLA, THE NIBBLER.

GENERIC characters, Antennæ filiform, serrated; head bent down, when disturbed. Feelers compressed-clavate, obliquely truncated; wing-sheaths curving downwards towards the tip; lamina broad, before the thighs, at the base of the abdomen. The species are 24.

The

The ARMED NIBBLER, *Mordella aculeata*.

Two or three lines in length: it is entirely black, and of a smooth surface; the abdomen is compressed, and terminates in a spine or sharp process extending beyond the wing-sheaths; the legs are rather long, and the insect, when disturbed, has the power of leaping or springing to a small distance. It is usually found on plants, in gardens, &c. in Great Britain.

The YELLOW NIBBLER, *Mordella flava*.

Yellow of a dark shade of that colour. The elytra bend downwards at the extremity, where they assume a ferruginous colour; the point of the abdomen, which extends beyond them, is of an obscure black. Inhabits Europe on umbellate flowers.

STAPHYLINUS, THE STAPHYLINUS.

GENERIC characters, Antennæ moniliform; the elytra seem as if cut through by the middle, and do not extend half the length of the abdomen; under these cases the wings are folded up, and concealed; the extremity of the abdomen is unarmed, but provided with two oblong vesicles which the insect can shoot out or retract, at pleasure. The staphylinæ are sometimes seen upon flowers; but their principal resort is to the dung of cows. All of them when touched turn up the tail, as if with an intention to sting; they are, however, unprovided with that instrument, but bite severely with their jaws when laid hold of. In their larva state, these insects so much resemble the perfect animal, that they cannot easily be distinguished. There are 156 species.

The SNOUTED STAPHYLINUS, *Staphylinus maxillofus*.

The largest British insect of this genus. The jaws, from which it obtains its Linnæan name, are sharp, hard,

OF COLEOPTEROUS INSECTS. 167

hard, and rather longer than the head. The whole insect, both above and below, is of a deep black: the elytra do not cover more than one third of the abdomen, which appears beyond them, rough and hairy. The legs are long; each of the tarsi is provided with a tuft of hair resembling a brush. This and the other species can fly by means of large wings, which unfold from under the elytra.

The RED-WINGED STAPHYLINUS, *Staphylinus erythropterus*.

Smaller than the preceding, and readily distinguished by the colour of its wing-sheaths, which are of a dull brick red. It is found about dunghills and in damp places, in several parts of Europe.

FORFICULA, THE EARWIG.

GENERIC characters, Antennæ setaceous; feelers unequal, filiform; shells half as long as the abdomen; wings folded up under the shells; tail armed with a forceps. There are 18 species, no more than two of which are natives of England. We need therefore only notice

The COMMON EARWIG, *Forficula auricularia*.

Specific character, colour dark chestnut, forceps curved, toothed at the base; fourteen joints in the antennæ. This is an insect so familiarly known that a formal description might seem unnecessary. Its structure however is highly curious, and its natural history well worthy of particular observation. The wings of this insect are remarkably elegant, and are convoluted beneath their small sheaths in so curious a manner that they cannot be viewed without admiration; they are very large in proportion to the animal, transparent, and slightly iridescent. The earwig flies only by night, and it is not without great difficulty that it can be made to expand its wings by day;

day : it is even probable that they would receive injury by any long exposure to the diurnal air ; the animal therefore keeps them completely covered ; and indeed so unusual a circumstance is it to see them expanded, that many people are not aware that they have wings.

The female earwig deposits her eggs, which are rather large for the size of the animal, of a white colour, and of an oval shape, under stones or in any damp situation, where they may be secure from too much heat or drought. From these eggs are hatched the young larvæ, which are at first very small, but have very much the general aspect of the parent animal, except that they are of a white or whitish colour, and that the blades of the forceps at the tip of the abdomen are not yet curved inwards. The parent insect, according to the observations of Degeer, guards and broods over her young nearly in the same manner as a hen does over her chickens ; and they generally remain close to the sides, or under the abdomen of the parent for several hours in the day. They change their skin at certain intervals during the earlier stages of their growth ; and after each change acquire a darker colour and a greater degree of resemblance to the full-grown insect ; till at length the wing-sheaths and wings are formed, and the animals may be considered as perfect.

The life of the earwig, after it enters upon its winged state, lasts but a few days ; each sex is then constantly in pursuit of the other, and that short existence seems chiefly employed in the business of procreation : after having provided for posterity, the parent animal dries up, and dies to all appearance consumptive.

The usual food of the earwig consists of decayed fruit, and other vegetable substances, and it does not seem to be naturally carnivorous, though, if kept without proper nourishment, it will, like many other animals,

OF HEMIPTEROUS INSECTS. 169

animals, occasionally attack and devour even its own species.

The forceps in the tail has occasioned the generic name of *forficula*; and has, in many eyes, rendered the appearance of this insect formidable; though in reality the part is too feeble to inflict a pinch, which many dread. The idea also of its introducing itself into the human ear, and of causing great pain, and even death, is equally unfounded. If this were among its natural habits, it would also infest the ears of brute animals; a thing wholly unheard of. Nothing, in fact, is so repugnant to its habits as that glutinous matter which the ear supplies, and which would be a great impediment to the freedom of its motions. In the summer encampments a few years since, several regiments were assigned some ground on the downs near Winchester which swarmed with these insects. During the whole season only a single instance occurred of an earwig's getting into the human ear: one soldier met with the accident of an earwig's falling into his ear from the top of the tent in which he lay asleep; but even this occasioned him no great inconvenience; the insect could make but little way, and was at once killed by pouring a little oil into the ear, and extracted by syringing with warm water.

ORDER II. HEMIPTEROUS INSECTS.

THIS Order comprehends the different kinds of locusts and grasshoppers, and, in general, all those animals whose antennæ are setaceous, and heads inflexed. Their elytra and wings are extended, smooth, and semicoriaceous; being of a substance somewhat like vellum. The thorax is horizontally flattened, of an orbicular form, and margined round the extremities: the feet are formed, in most species, for running; and the abdomen is terminated by two small appendages resembling horns. They are termed

hemiptera, because only half of their wings appear when in a state of rest: they do not then meet together in a longitudinal suture like those of the last order, but have some part of their interior margins crossed, or laid one over the other, above the abdomen, the base of the left covering the inner margin of the base of the right. This order comprehends fourteen genera.

BLATTA, THE COCKROACH.

GENERIC characters, Head inflexed; antennæ fetaceous, feelers unequal, filiform; wing-cases and wings smooth, somewhat coriaceous; thorax rather flat, orbicular, margined; legs formed for running; abdomen terminating in four spines or bristles. They exclude an uncommonly large egg, or rather a connate groupe of eggs. These insects, like the cricket, frequent our kitchens and bakehouses; they are, however, but rarely seen. The wings of the female in some species are totally unfit for flight. These insects in warm climates enter houses, and commit various depredations on the furniture, devour provisions of every kind, gnaw holes in clothes, torment the inhabitants with their bite, and do considerable injury. The species of blatta most abundant in England was originally a native of Asia, from whence it was long since imported into Europe, and is now completely naturalized to this climate. Another species was also introduced with the raw sugars brought many years ago to Europe from America. All the species, whether in the larva, pupa, or perfect winged state, secrete themselves in the day time, and wander about during the night in search of food. In allusion to this circumstance the ancients called them *lucifugæ*, or insects that shun the light. Except in being completely destitute of wings and wing-cases, the larva resembles the perfect insect, and in the pupa state nothing more than the rudiments of the wings are perceptible.

OF HEMIPTEROUS INSECTS. 171

perceptible. In the dark they are remarkably active in all their motions; and on the least disturbance, or the return of light, retreat again to their lurking-places with timidity and precipitation. The fumes of charcoal may be employed with success in destroying them.—There are forty-seven species now known. The most remarkable are the following :

The GIGANTIC COCKROACH, *Blatta gigantea*.

Specific character, a square brown spot on the shield of the thorax.

This is the largest species of the genus, being nearly as large as a hen's egg. It is a native of many of the warmer parts of Asia, Africa, and South-America. It is this species in particular which seems to be intended in the following description of the ravages of this genus by an excellent observer who had contemplated the animals in their native climes. "The cockroaches are a race of pestiferous beings, equally noisome and mischievous to natives or strangers, but particularly to collectors. These nasty and voracious insects fly out in the evenings, and commit monstrous depredations: they plunder and erode all kinds of victuals, drest and undrest, and damage all sorts of clothing, especially those which are touched with powder, pomatum, and similar substances: every thing made of leather, books, paper, and various other articles, which if they do not destroy, at least they soil, as they frequently deposit a drop of their excrement where they settle, and some way or other by that means damage what they cannot devour. They fly into the flame of candles, and sometimes into the dishes; are very fond of ink and of oil, into which they are apt to fall and perish. In this case they soon turn most offensively putrid, so that a man might as well sit over the cadaverous body of a large animal as write with the ink in which they have died. They often fly into persons' faces or bo-

soms, and their legs being armed with sharp spines, the pricking excites a sudden horror not easily described. In old houses they swarm by myriads, making every part filthy beyond description wherever they harbour, which in the day-time is in dark corners, behind all sorts of clothes, in trunks, boxes, and in short every place where they can lie concealed. In old timber and deal houses, when the family is retired at night to sleep, this insect, among other disagreeable properties, has the power of making a noise which very much resembles a pretty smart knocking with the knuckle upon the wainscoting. The *Blatta gigantea* of Linnæus in the West Indies is therefore frequently known by the name of the *drummer*. Three or four of these noisy creatures will sometimes be impelled to answer one another, and cause such a drumming noise that none but those who are very good sleepers can rest for them. What is most disagreeable, those who have not gauze curtains are sometimes attacked by them in their sleep: the sick and dying have their extremities attacked, and the ends of the toes and fingers of the dead are frequently stripped both of the skin and flesh." Drury's *Exotic Insects*, Pref. to vol. iii.

This horrible insect seems to be at present unknown in the European world, though other species have been introduced by ships from the warmer regions, and are become nuisances in our habitations and warehouses: yet, from an observation recorded by Mouffet, it should seem that a specimen of the *Blatta gigantea* had by some means found its way long ago into our country, since it is hardly possible to apply the description to any other known kind. "I have heard from persons of good credit, that one of these *Blattæ* was found and taken in the top of the roof of the church at Peterborough, which was six times larger than the common *Blatta*, and which not only pierced the skin of those who endeavoured to seize it, but
bit

bit so deep as to draw blood in great quantity; it was a thumb's length and breadth in size, and being confined in a cavity of the wall, after two or three days made its escape, no one knew how."

The AMERICAN COCKROACH, *Blatta Americana*.

Specific character, colour light chestnut, with the shield of the thorax whitish behind. This was long ago described and elegantly figured by Mad. Merian, in her work on the insects of Surinam. It is extremely common in the warmer parts of America and the West India islands; and is the species brought to England in raw sugar. See correct figures of the male and female, and larva, in the introductory Plates of Entomology. The male is shewn in Plate I. fig. 3; the female and her egg, at fig. 4; and the larva in Plate II. fig. 23.

COMMON BLACK COCKROACH, *Blatta orientalis*.

Yellowish-brown or parchment colour; wing-cases abbreviated, with an oblong groove. The female has the mere rudiments of wing-cases and wings. This species, which is frequently called in our metropolis and elsewhere by the erroneous name of the *black-beetle*, is supposed to have been first imported from the eastern parts of the world, and seems to have made great progress of late years in extending itself throughout the kingdom.

The other species are: *Blatta maderæ*, *occidentalis*, *ægyptiaca*, *surinamensis*, *australasiæ*, *erythrocephala*, *capensis*, *indica*, *gallica*, *nivea*, *irrorata*, *viridis*, *brasiliensis*, *petiveriana*, *cincta*, *picta*, *variegata*, *lapponica*, *germanica*, *livens*, *ruficollis*, *diaphana*, *maculata*, *marginata*, *oblongata*, *nitidula*, *hemiptera*, *fusca*, *deusta*, *chlorotica*, *latissima*, *aterrima*, *perspicillaris*, *asiatica*, *schæfferi*, *sylvestris*, *pennsylvanica*, *livida*, *rufa*, *grisea*, *minutissima*, *aptera*, *punctulata*, *ocellata*.

PNEUMORA,

PNEUMORA, THE PNEUMORA.

GENERIC characters, Body ovate, inflated, diaphanous; head inflected, armed with jaws; thorax convex, carinate beneath: wing-cases deflected, membranaceous: legs formed for running. The insects of this genus appear to consist of a mere hollow inflated membrane. By rubbing together their ferrate or toothed legs, they make a shrill kind of noise morning and evening, and follow a light; and are so nearly allied to the Cricket tribe, that Fabricius has enumerated them under the genus Gryllus. There are but three species; natives of the Cape of Good Hope.

MANTIS, THE SOOTHSAYER.

GENERIC characters, Head unsteady; mouth armed with jaws; feelers filiform; wings four, membranaceous; convolute, the under ones plaited; fore-legs compressed, ferrate or toothed beneath, armed with a single claw and lateral jointed process; the four hind-ones smooth and formed for walking: thorax (mostly) linear, elongated, and narrow.

The insects of this genus possess a form the most romantic and extraordinary that is perhaps presented by any animated being; and so powerfully have their singular attitudes operated on the minds of the credulous and ignorant, that superstition has invested them with certain powers that are altogether unexemplified by any part of the history of animated nature. By the singular manner in which the soothsayer stretches out its fore legs, it has acquired the reputation of a diviner, who could unfold all the secrets in the bosom of futurity; and because the insect often sits upon its four hind legs, having the two fore ones raised up and folded together, the believing multitude have supposed it to be then holding intercourse with the Supreme Power, in the exercise of devotion; a circumstance

circumstance from which it has obtained from the peasants of Languedoc the name of *Pregadiou*, or the God-prayer. It is in that province, where these animals abound, that the country people have also ascribed to the soothsayer another very commendable quality; that of obligingly shewing the way to strangers: this it is supposed to do, by that peculiar habit which it has of stretching its fore legs sometimes to the right, and sometimes to its left side. These superstitions of the vulgar have been as favourable to the security of these animals, as they are disgraceful to human reason; for they have procured them a character almost sacred; and the injuring them is reckoned a crime of no small enormity. There are 64 species.

The GIANT SOOTHSAYER, *Mantis gigas*.

Specific character, thorax roundish, rough; wing-veins very short; legs spinous. This and a few more of the *Mantes* have been separated by some writers into a distinct genus, *Phasma*; they differ in having all the legs equally formed for walking, or without the falciform joint which distinguishes the fore-legs in most of the genus *Mantis*. The antennæ are setaceous, and the head large and broad: to these characters may be added the shortness of the upper wings or hemelytra, which scarcely cover more than about a third part of the body, while the lower wings are often very large and long. In their mode of life these species differ from the *Mantes*; feeding entirely on vegetable food. We have thought it best, however, not to vary from the Linnæan classification.

The giant soothsayer measures six or eight inches in length, and is of a very lengthened shape both in thorax and abdomen, which are of a subcylindric form, the thorax being roughened on the edges and upper surface by numerous small spines or tubercles. The upper wings are small, green, and veined like the

the leaves of a plant, while the lower are very ample, reaching half the length of the body or farther, of a very pale transparent brown, elegantly varied and tessellated by darker spots and patches: the legs are of moderate length, with the joints roughened by spines.

The larva and pupa of this species bear a more singular appearance than even the complete insect, greatly resembling, on a general view, a piece of dry stick with several small broken twigs adhering to it: for this reason it has been generally known in collections by the name of the *walking-stick*, and under this title is figured in Edwards's Gleanings of Natural History, and many other publications. It is however probable, that, though of a pale brown in its dry state, it is in reality green when living; the natural colour fading after death, as in many others of this tribe. It is a native of the island of Amboyna. It may be added, that this insect either runs into several varieties as to size and some other particulars, or that there exist in reality many distinct species, which have been confounded under one common name; for Mr. Donovan, in his Epitome of the Insects of China, mentions a specimen nearly thirteen inches in length. In the Leverian Museum there was a very capital specimen, which has been figured in the Naturalist's Miscellany; but the best representation yet given is in the incomparable work of Stoll.

The BROAD SOOTHSAYER, *Mantis dilatatum*.

This species seems to have been first described in the fourth volume of the Transactions of the Linnæan Society by Mr. John Parkinson. It was preserved in the Leverian Museum. The account given in the Linnæan Transactions runs as follows.

“ This singular animal, which appears to be a species hitherto undescribed, is at present in the Leverian Museum. It is supposed to be a native of Asia,
and

and belongs to that tribe of insects which Stoll has called *speculæres*, and which constitute a distinct genus from that of Mantis. The present species measures six inches and a quarter from the upper part or top of the head to the extremity of the abdomen. The whole animal is of a flattened form, more especially on the abdomen, which measures about an inch and half across in its broadest part: the thorax is of an obtusely rhomboidal form, the sides sloping each way from the flattish upper part. The whole thorax is not only edged with spines, but has also several very sharp ones distantly scattered over its surface. The head rises up backwards into an obtusely conic shape, and has several very strong and large spines or processes. The abdomen is edged, almost throughout its whole length, with a continued series of small spines, to the number of five on the side of each individual segment: the extreme segments are without spines. The thighs or first joints of the lower pair of legs are in this insect remarkably strong, of a somewhat triangular shape, and beset with some strong spines; but the tibiae or second joints are armed with far larger and stronger ones. The upper and middle pair of legs are of a nearly similar structure in proportion, but much less strongly spined. The colour of all the legs is green, tinged with brown; the spines blackish: the general colour of the thorax, abdomen, and head, is now brown, but might probably have been green in the living animal. The wings are scarcely larger than the elytra or wing-sheaths, and seem originally to have been reddish, a tinge of that colour still pervading some parts of the wings: the tips are green: these wings are very strongly veined with brown fibres: the wing-cases are of a strong opaque green, and were doubtless more vivid in the living insect: they have a great resemblance to a pair of leaves. The mouth has four palpi, which are rather long, and under the mouth are situated two leaf-

shaped organs, perhaps belonging to the action of that part. The antennæ are wanting, the first joints alone remaining. The abdomen is terminated by a kind of boat-shaped organ, the keel of which possesses a considerable space beneath the abdomen, so that fewer segments appear on that part than above. The concavity of this organ is covered by a terminal scale and bifid process, constituting the tip of the abdomen on the upper part. On raising this valve, an ovum, nearly of the size of a pea, but of a more lengthened form, was discovered lying in the cavity beneath; and, on inspecting farther into the cavity of the abdomen, a great many more ova, exactly similar, were found, to the number of five or six and twenty, some still remaining in the upper part: these eggs are of a slightly oblong shape, but flattened at one end: they are of a brown colour, and marked all over with numerous impressed points; and have on one side a mark or double waved line, so disposed as to represent a kind of cross, as if carved on the surface: the flattened end is surrounded by a small rim or ledge, and seems to be the part which opens at the exclusion of the larva, since it readily separates from the rest. On immersing some of these ova in warm water, and opening them, the included yolk, of a deep yellow colour, and of the appearance of a transparent gum, was discovered; and this, when burned, afforded the usual smell of animal substances, but in some it was accompanied by a slight degree of fragrance. It is perhaps needless to observe that these mature ova clearly prove the insect to be in its complete or ultimate state, and not that of a larva."—*Phasma dilatatum*, *Shaw's Gen. Zool.*

THE CHINESE SOOTHSAYER.

Thorax uncommonly long and narrow; head small and flat, with two short filiform antennæ; behind these, two large polished eyes are placed; the rostrum has

OF COLEOPTEROUS INSECTS. 179

has the shape of an awl, but often split towards the extremity into two points. The elytra, which cover two thirds of the body of the insect, are reticulated, and crossed the one over the other; the wings which they cover are veined and diaphanous. The four hind legs have the appearance of being winged, on account of those large membranous lobes which emerge from their joints. The anterior pairs are armed with spines at their first articulation, and towards their extremities they are ferrated on one side. The whole insect, from its thin limbs, and the grotesque form of its body, especially in its dried state, seems to resemble the conjunction of several fragments of withered stalks, &c. This also is the case with the larvæ of many of the genus, before the wings are formed.

The WALKING LEAF, *Mantis ficcifolia*.

Body very much dilated and rounded; thorax denticulate; thighs oval and membranaceous. The wings, when closed, so strongly resemble the appearance of a leaf, that the insect is frequently known in cabinets under the name of the *walking leaf*, as the larva of the gigas is by that of the walking stick. The female of this species has no under-wings.

The CAMEL CRICKET, *Mantis oratoria*.

Thorax smooth; wing-cases green, without spots. This is the chief of the European species; it is however a stranger to the British isles, but is found in most of the warmer parts of Europe. It is nearly three inches in length, of a slender shape, and in its general sitting posture is observed to hold up the two fore-legs, slightly bent, as if in an attitude of prayer: for this reason the superstition of the vulgar has conferred upon it the reputation of a sacred animal, and a popular notion has often prevailed, that a child or traveller, having lost his way, would be safely directed

by observing the quarter to which the animal pointed when taken into the hand. In its real disposition it is very far from sanctity; preying with great rapacity on any of the smaller insects which fall in its way, and for which it lies in wait with anxious assiduity in the posture at first mentioned, seizing them with a sudden spring when within its reach, and devouring them. It is also of a very pugnacious nature, and, when kept with others of its own species in a state of captivity, will attack its neighbour with the utmost violence, till one or the other is destroyed in the contest. Roësel, who kept some of these insects, observes that in their mutual conflicts their manœuvres very much resemble those of buffars fighting with sabres; and sometimes one cleaves the other through at a single stroke, or severs the head from its body. During these engagements the wings are generally expanded, and when the battle is over the conqueror devours his antagonist.

Among the Chinese this quarrelsome property in the genus *Mantis* is turned into a similar entertainment with that afforded by fighting cocks and quails: for it is to this insect, or one closely allied to it, that we suppose the following passage in Mr. Barrow's account of China to allude. "They have even extended their enquiries after fighting animals into the insect tribe, and have discovered a species of locust that will attack each other with such ferocity as seldom to quit their hold without bringing away at the same time a limb of their antagonist. These little creatures are fed and kept apart in bamboo cages, and the custom of making them devour each other is so common that, during the summer months, scarcely a boy is to be seen without his cage of grasshoppers." Travels in China, p. 159.

The SACRED SOOTHSAYER, *Mantis precaria*.

Native of many parts of Africa, and is the supposed

OF COLEOPTEROUS INSECTS. 181

posed idol of the Hottentots, which those superstitious people are reported to hold in the highest veneration, the person on whom the adored insect happens to light being considered as favoured by the distinction of a celestial visitant, and regarded ever after in the light of a saint. This species is of the same general size and shape with the preceding, and is of a beautiful green colour, with the thorax ciliated or spined on each side, and the upper wings each marked in the middle by a semi-transparent spot.

GRYLLUS, THE LOCUST.

THE word Gryllus is from the Greek γρυλλίζω, to chirp, which expresses the noise made by many species of this genus, which includes the Locusts, Crickets, Grasshoppers, &c. Generic characters: Head inflexed, armed with jaws; feelers filiform; antennæ setaceous or filiform; wings four, deflexed, convolute; the lower ones plaited; hind legs formed for leaping: claws double on all the feet.

The insects of this genus feed on plants and herbs, except those of the division *Truxalis*, which prey on other insects: the larvæ and pupæ resemble the perfect insects, reside chiefly under ground, and are six-footed, voracious and active: they were the only animals of this class which Moses permitted the Israelites to eat, and are at present used as an article of food by the natives of Africa and India. The genus consists of 252 species, which are classed in five separate divisions or families, viz.

I. *Truxalis*. *Antennæ ensiform; head conic, longer than the thorax.*

The SNOUTED GRYLLUS, *Gryllus nasutus*.

Head conic; body green. The mouth is placed at the base of the head; the antennæ at the tip: the wings are sometimes hyaline. Inhabits Africa.

The

The STRIPED GRYLLUS, *Gryllus vittatus*.

Head prominent; body testaceous; head, thorax, and hind-thighs, with a lateral silvery stripe. Antennæ testaceous; the silvery stripe is drawn through the head and thorax to the tip of the hind-thighs; hind-thighs with a bluish fillet and a line of silvery dots. Inhabits China.

The CRENULATED GRYLLUS, *Gryllus crenulatus*.

Head a little prominent; body green; wings rose-colour at the inner margin. Antennæ green, sometimes yellow at the base; head and thorax sometimes variegated with yellow, the lateral edge crenulate; wing-cases acute, longer than the body; wings white; legs yellowish, with raised white dots; the hind-ones green, smooth. Inhabits Tranquebar.

The GIANT GRYLLUS, *Gryllus Giganteus*.

Green with two reddish fillets; antennæ ferruginous; thorax with three raised lines. Inhabits America.

II. Acrydium. Thorax carinate: antennæ filiform, shorter than the thorax, feelers equal.

The TWO-SPOTTED GRYLLUS, *Gryllus bipunctatus*:

Dark brown; scutel as long as the abdomen. Wings none; thorax with a black rhombic spot each side; a whitish line sometimes runs from the front through the middle of the scutel. Inhabits Europe.

The SHAGREEN GRYLLUS, *Gryllus granulatus*.

Varied with grey-green and blackish, rough with raised dots, and flattened at the sides; thorax suboval gibbous. Inhabits Berlin.

III. Acheta. Antennæ setaceous: feelers unequal; thorax rounded; tail with two bristles.

The

OF COLEOPTEROUS INSECTS. 183

The MOLE-CRICKET, *Gryllus gryllotalpa*.

Wings, when enclosed, terminate in slender tails longer than the abdomen : fore-feet palmate.

The mole-cricket is an insect of a very unpleasant form. Its head, in proportion to the size of its body, is small and oblong, with four long thick palpi, and two long antennæ as slender as threads. Behind the antennæ are situated the eyes, and between those two eyes are three stemmata, or smaller eyes, amounting to five in all, set in one line transversely. The thorax forms a kind of cuirass, oblong, almost cylindrical, which appears as it were velvety. The elytra, which are short, reach but to the middle of the abdomen, are crossed one over the other, and have large black or brown nervous fibres. The wings terminate in a point, longer not only than the elytra, but even than the abdomen; this latter is soft, and ends in two points or appendages of some length. But what constitutes the chief singularity of this insect are its fore-feet, which are very large and flat, with broad legs, ending outwardly in four large serrated claws, and inwardly in two only; between which claws is situated, and often concealed, the tarsus. The whole animal is of a brown dusky colour. It haunts moist meadows, and frequents the sides of ponds and banks of streams, performing all its functions in a swampy wet soil. With a pair of fore-feet curiously adapted to the purpose, it burrows and works under ground like the mole; raising a ridge as it proceeds, but seldom throwing up hillocks.

As mole-crickets often infest gardens by the sides of canals, they are unwelcome guests to the gardener, raising up ridges in their subterraneous progress, and rendering the walks unsightly. If they take to the kitchen quarters, they occasion great damage among the plants and roots, by destroying whole beds of cabbages, young legumes, and flowers. When dug out,
they

they seem very slow and helpless, and make no use of their wings by day; but at night they come abroad, and make long excursions. In fine weather, about the middle of April, and just at the close of day, they begin to solace themselves with a low, dull, jarring, note, continued for a long time without interruption, and not unlike the chattering of the *Caprimulgus*, or goat-sucker, but more inward. About the beginning of May they lay their eggs, as Mr. White informs us, who was once an eye-witness: "for a gardener at a house where he was on a visit, happening to be mowing, on the 6th of that month, by the side of a canal, his scythe struck too deep, pared off a large piece of turf, and laid open to view a curious scene of domestic economy: there were many caverns and winding passages leading to a kind of chamber, neatly smoothed and rounded, and about the size of a moderate snuff-box. Within this secret nursery were deposited near one hundred eggs of a dirty yellow colour, and enveloped in a tough skin, but too lately excluded to contain any rudiments of young, being full of a viscous substance. The eggs lay but shallow, and within the influence of the sun, just under a little heap of fresh-mowed mould, like that which is raised by ants."

The LONG-HORNED CRICKET, *Gryllus monstrosus*.

Wing-cases and wings tailed, convolute. Antennæ longer than the body; flanks spinous; feet dilated, lobate. Inhabits India.

The HOUSE-CRICKET, *Gryllus domesticus*.

Wings tailed, longer than the wing-cases; body glaucous.

This is an inhabitant of almost every house, but it is said to delight in new-built houses; being, like the spider, pleased with the moisture of the walls; and besides, the softness of the mortar enables them
to

to burrow and mine between the joints of the bricks or stones, and to open communications from one room to another. Yet they are particularly fond of kitchens and baker's ovens, on account of their perpetual warmth. Tender insects that live abroad either enjoy only the short period of one summer, or else doze away the cold uncomfortable months in profound slumbers; but these, says Mr. White, residing as it were in a torrid zone, are always alert and merry: a good Christmas fire is to them like the heats of the dog-days. Though they are frequently heard by day, yet is their natural time of motion only in the night. As soon as it grows dusk, the chirping increases, and they come running forth, and are from the size of a flea to that of their full stature. As one should suppose, from the burning atmosphere which they inhabit, they are a thirsty race, and shew a great propensity for liquids, being found frequently drowned in pans of water, milk, broth, or the like. Whatever is moist they affect; and therefore often gnaw holes in wet woollen stockings and aprons that are hung to the fire. These crickets are not only very thirsty, but very voracious; for they will eat the scummings of pots; yeast, salt, and crumbs of bread; and any kitchen offal or sweepings. In the summer we have observed them to fly, when it became dusk, out of the windows, and over the neighbouring roofs. This feat of activity accounts for the sudden manner in which they often leave their haunts, as it does for the method by which they come to houses where they were not known before. It is remarkable, that many sorts of insects seem never to use their wings but when they have a mind to shift their quarters and settle new colonies. When in the air they move in waves or curves, like wood-peckers, opening and shutting their wings at every stroke, and so are always rising and sinking. When they increase to a great degree, they become noisome pests, flying into the candles, and dashing

into people's faces ; but may be blasted with gunpowder discharged into their crevices and crannies. Cats catch house-crickets, and, playing with them as they do with mice, devour them. Crickets may be destroyed, like wasps, by phials half-filled with beer, or any liquid, and set in their haunts ; for, being always eager to drink, they will crowd in till the bottles are full. A popular prejudice, however, frequently prevents their being driven away and destroyed : the common people imagine that their presence brings a kind of luck to the house while they are in it, and think it would be hazardous to destroy them.

The FIELD-CRICKET, *Gryllus campestris*.

Wings shorter than the wing-cases ; body blackish ; style linear.

Towards sun-set is the time the field-cricket likes best to appear out of its subterraneous habitation. In White's Natural History of Selbourne, a very pleasing account is given of the manners and economy of these insects ; which, however, are so shy and cautious, he observes, that it is no easy matter to get a sight of them ; for, feeling a person's foot-steps as he advances, they stop short in the midst of their song, and retire backward nimbly into their burrows, where they lurk till all suspicion of danger is over. At first it was attempted to dig them out with a spade, but without any great success ; for either the bottom of the hole was inaccessible from its terminating under a great stone ; or else, in breaking up the ground, the poor insect was inadvertently squeezed to death. Out of one so bruised a multitude of eggs were taken, which were long and narrow, of a yellow colour, and covered with a very tough skin. More gentle means were then used, and proved successful : " A pliant stalk of grass, gently insinuated into the caverns, will probe their windings to the bottom, and quickly bring out the inhabitant ; and thus the humane inquirer may gratify

gratify his curiosity without injuring the object of it. It is remarkable, that though these insects are furnished with long legs behind, and brawny thighs for leaping, like grasshoppers; yet when driven from their holes they show no great activity, but crawl along in a shiftless manner, so as easily to be taken: and again, though provided with a curious apparatus of wings, yet they never exert them when there seems to be the greatest occasion. The males only make that shrilling noise perhaps out of rivalry and emulation, as is the case with many animals which exert some sprightly note during their breeding-time: it is raised by a brisk friction of one wing against the other. They are solitary beings, living singly male or female, each as it may happen; but there must be a time when the sexes have some intercourse, and then the wings may be useful perhaps during the hours of night. When the males meet they will fight fiercely, as our author found by some which he put into the crevices of a dry stone wall, where he wanted to have made them settle: for, though they seemed distressed by being taken out of their knowledge, yet the first that got possession of the chinks would seize on any that were obtruded upon them with a vast row of serrated fangs. With their strong jaws, toothed like the shears of a lobster's claws, they perforate and round their curious regular cells, having no fore-claws to dig like the mole-cricket. When taken in the hand, they never offered to defend themselves, though armed with such formidable weapons. Of such herbs as grow before the mouths of their burrows they eat indiscriminately; and on a little platform, which they make just by, they drop their dung; and never, in the day-time, seem to stir more than two or three inches from home. Sitting in the entrance of their caverns, they chirp all night as well as day from the middle of the month of May to the middle of July; in hot weather, when they are most vigorous, they make the

hills echo; and in the stiller hours of darkness may be heard to a considerable distance. In the beginning of the season their notes are more faint and inward; but become louder as the summer advances, and so die away again by degrees. Sounds do not always give us pleasure according to their sweetness and melody; nor do harsh sounds always displease. We are more apt to be captivated or disgusted with the associations which they promote, than with the notes themselves. Thus the shrilling of the field-cricket, though sharp and stridulous, yet marvellously delights some hearers, filling their minds with a train of summer ideas of every thing that is rural, verdurous, and joyous.

“About the tenth of March the crickets appear at the mouths of their cells, which they then open and bore, and shape very elegantly. In August their holes begin to be obliterated, and the insects are seen no more till spring. Not many summers ago I endeavoured to transplant a colony to the terrace in my garden, by boring deep holes in the sloping turf. The new inhabitants staid some time, and fed and sung; but wandered away by degrees, and were heard at a farther distance every morning; so that it appears that on this emergency they made use of their wings in attempting to return to the spot from which they were taken. One of these crickets, when confined in a paper cage and set in the sun, and supplied with plants moistened with water, will feed and thrive, and become so merry and loud as to be irksome in the same room where a person is sitting: if the plants are not wetted, it will die.”

THE MEMBRANOUS CRICKET, *Gryllus membranaceus*.

Pale testaceous; thorax with a yellowish collar; wings tailed, ochraceous. Inhabits the Deserts of Ural.

These three first divisions of Locusts are exemplified

fied in the *GRYLLUS* Plate I. where fig. 1 represents the *nasutus*; 2, the *gigantæus*; 3, the *bipunctatus*; 4, the *granulatus*; 5, the mole-cricket; 6, the female of the same; 7, the *monstrosus*; 8, the *membranaceus*.

IV. *Locusta*. *Antennæ fetaceous; feelers unequal; male with an ocellate spot at the base of each wing-case; tail of the female armed with a sword-like projection.*

This division includes many of the grasshoppers commonly so called. The female grasshopper carries, at the extremity of her abdomen, a kind of ferrated spine, composed of two laminæ, and in shape broad, and turned up like the blade of a cutlass. These implements are employed by the female in digging in the ground, or in wood, holes for the reception of her ova; and this being a function in which the male has no share, he is unprovided with the instruments by which it is performed. The female grasshopper possesses an amazing fecundity; she regularly deposits from four to seven hundred eggs at a time. The wonderful precautions which she takes for providing them security, and food for the young as soon as they are disclosed, merit our particular notice. With that lancet, which we have already described, she excavates a number of holes in the dried branch of a tree; into each of these holes eight or ten of her eggs are dropped; they are surrounded with that kind of food which is most suitable for them in their larvæ state. The disposition of the eggs is in rows, and placed in the middle of the trees; the soft substance of which is the first food of the insect after it leaves the ovum. The insect that proceeds from each of these eggs, after it has grown for some time, and before reaching a size incompatible with escaping by the narrow mouth of the hole, takes a final departure from the place of its birth.

The larvæ, having thus left their egg state, and acquired

quired the use of their limbs, the two anterior of which are formed for digging the ground, soon apply them to that purpose, and excavate for themselves a subterraneous retreat among the roots of plants, which they gnaw, and support themselves upon the juices that exsude from them. In this state they remain till they are ready to undergo another transformation, which introduces them into the open air in the form of winged insects. A short time after, the grasshopper appears in its last stage of perfection; it spreads over the meadows, which it fills with its chirruping strains, the calls of the male inviting the female to love. Some naturalists are of opinion that the notes of the grasshopper are produced by rubbing the two hind legs of the animal against each other. Reaumur and Linnæus, who minutely examined these insects, derive their vocal powers from a very different source. On examining the male, his body has been found provided with a small hole below the insertion of each wing, delicately constructed with organs of sound within, and covered over externally with a fine transparent membrane. It is by means of these organs, which, in the completeness and delicacy of their structure, may vie with those of the human voice, that some species of the grasshoppers produce their melody.

The note of the grasshopper is seldom heard without being returned by another male of the same species: and the two little animals, after many mutual insults of this kind, are seen to meet and fight desperately. The female is generally the reward of victory; for, after the combat, the male seizes her with his teeth behind the neck, and thus keeps her for several hours, till the business of fecundation is performed: they are at that time so strongly united, that they can scarcely be separated without tearing them asunder. After fecundation by the male, and towards the close of summer, the female is seen distended

tended with seeds of a future family ; and she prepares for depositing her numerous ova in the manner we have already mentioned. The eggs are white, of an oval shape, and horny consistency. In size, they are nearly equal to a grain of anise ; and while in the body of the female, they are enveloped within a covering, branched all over with veins and arteries. In this form they remain deposited under the surface of the earth, or inclosed in wood, apparently unaffected by the rigour of winter, till the heat of spring begins to hatch and vivify them. About the beginning of May each egg produces a larva about the size of a flea, at first of a white colour, but afterwards gradually turning brown. After having taken these measures for perpetuating her kind, the parent animal does not long survive ; as the winter approaches, she dries up, seems to feel the effects of age, and dies from a total decay. Some assert that she is killed by the cold ; others, that she is eaten by worms ; but certain it is, that neither male nor female are seen to survive the winter.

When examined internally, the grasshopper discovers a very singular and complicated structure of viscera ; besides the gullet, there is observed a small stomach ; and behind that a very large one ; still lower down, there is yet a third : so that it is not without some foundation, that all the animals of this tribe have been supposed to chew the cud, as they so much resemble ruminating animals in their internal conformation. Aristotle informs us, that they were greedily sought after as a delicate morsel by the Greeks ; and that the season when they were deemed most delicious was a short time before they left their chrysalis state. The metamorphosis from that state is performed with great difficulty and agitation ; many perish in this severe effort of nature, and those who survive are for some time in a languid and debilitated state.

The

THE NETTED GRASSHOPPER, *Gryllus reticularis*.

Specific character, thorax with three segments; wing-cases reticulate; wings brown; antennæ ferruginous, twice as long as the body. Head cinereous with a brown blotch at the base; thorax spinous reddish; wing-cases resembling a dead leaf, rounded, as long as the wings; sword short, recurved, cinereous tipped with black; legs ferruginous, sharply ferrate beneath. Inhabits Guadaloupe.

THE GREEN GRASSHOPPER, *Gryllus viridissimus*.

Head, thorax, and wing-cases, green, immaculate; antennæ very long. Legs yellowish; sword straight, ferrate. Inhabits Europe.

THE WART-EATING GRASSHOPPER, *Gryllus verrucivorus*.

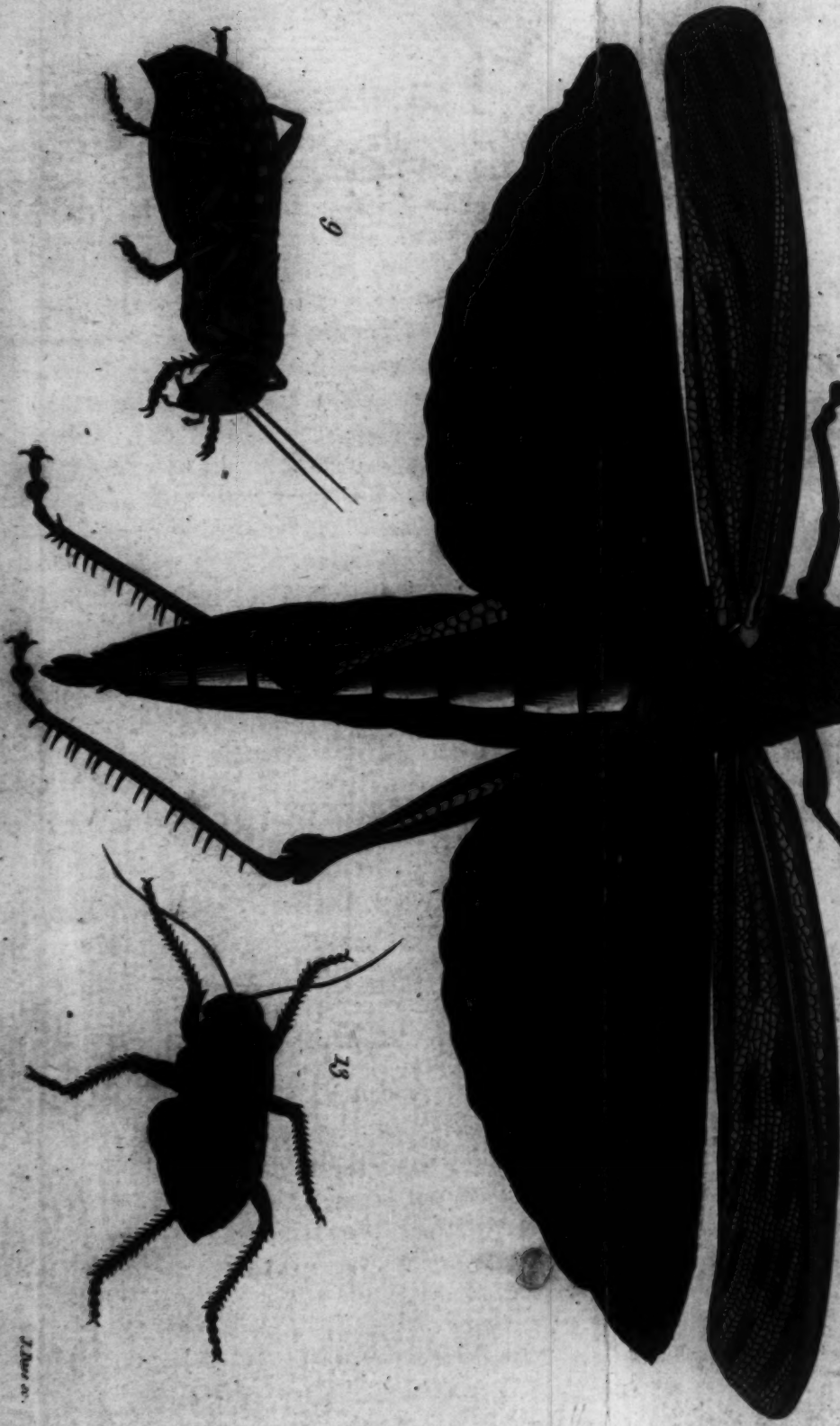
Wings green spotted with brown; antennæ as long as the body. Inhabits Europe, and is collected by the common people of Sweden for the purpose of destroying warts on the hands, which it is said to perform by biting off the excrescence, and discharging on the wound a corrosive liquor.

THE FIGHTING GRASSHOPPER, *Gryllus gladiator*.

Thorax rounded; wings linear, acute, longer than the cases; hind-thighs with a black spot at the tip. Antennæ much longer than the body, and with the head testaceous; thorax testaceous with black dorsal blotches; wing-cases hyaline reticular; sword straight narrow; legs testaceous. Inhabits Tranquebar.

THE PRICKLY GRASSHOPPER, *Gryllus spinulosus*.

Thorax muricate and surrounded with spines; body apterous. Antennæ as long as the body; abdomen black with testaceous spots; sword recurved. This is shewn at fig. 9. Plate II. It inhabits India; and
is



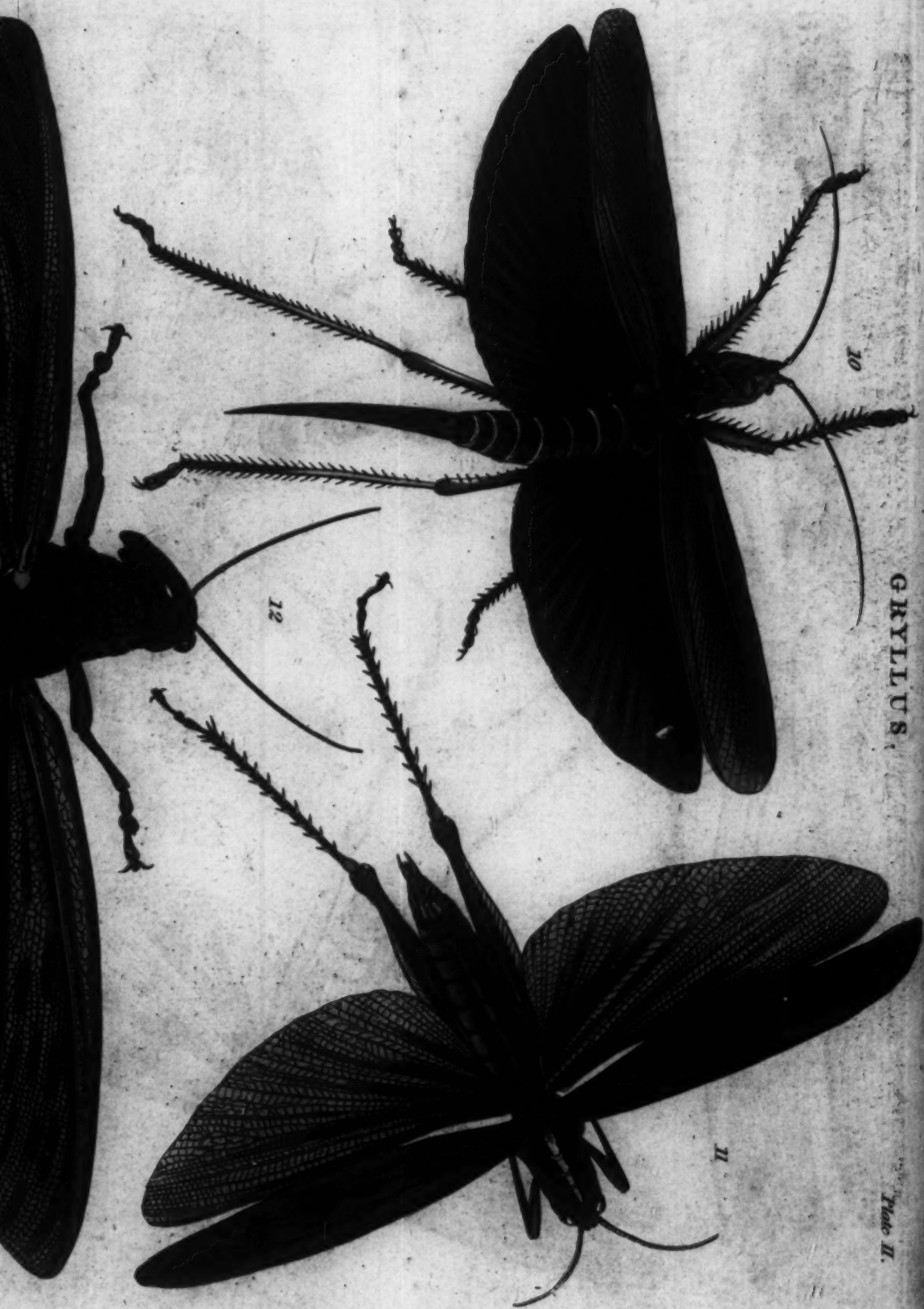
Species of the fourth and fifth Divisions of Locusts.

Emmett's Natural History of the United States, by J. Emmett.

Table 20.

GRYLLUS.

PLATE II.



is perhaps the species noted by Mr. Jackson in his Journey from India, p. 139. "I here (between Diarbekir and Mosul) caught some locusts of an extraordinary size, and very thick in proportion to their length. They have no wings, move slowly, and are easily taken. I soon found it necessary to be careful that they did not bite me, for I am persuaded that they could easily have bitten my finger to the bone. I tried one with a twig about as thick as a quill, which it bit through instantly. I then dissected one, and on examining one of its grinders found it nearly as large as a human tooth, and so hard, that I was not able to make any impression on it with my pen-knife. The grinders were nearly the colour of mahogany. Finding that we were not molested by flies or other insects, and ascribing this circumstance to the excessive heat of the sun at this season, I made an experiment on one of these large locusts, by exposing it to the sun, which actually killed it in less than a hour. I also found that flies, when exposed in the middle of the day, fell down almost instantly; and that all kinds of insects must either get into some shade, or inevitably perish."

The INDIAN GRASSHOPPER, *Gryllus Indicus*.

Green; front obtuse, conic; thorax elevated before and behind; hollowed in the middle; abdomen and under wings brown. This species inhabits India. See Plate II. fig. 10.

The LONG-WINGED GRASSHOPPER, *Gryllus macrop-
terus*.

Thorax rounded; wings whitish with brown lines; longer than the immaculate wing-cases; abdomen terminating in four threads; hind-thighs beneath and four fore-thanks with four rows of spines. Inhabits out of Europe.

The LONG-HORNED GRASSHOPPER, *Gryllus longicornis*.

Thorax rounded, testaceous above; head green; front pointed, testaceous; antennæ very long. Wing-cases testaceous, half as long as the abdomen. Sword ascending, testaceous, green at the base. Inhabits Europe.

V. *Gryllus*. *Antennæ filiform; feelers simple; tail simple; throat with a horn-like protuberance.*

In this division we have the most formidable of the real Locusts. The annals of most of the warm countries are filled with accounts of the devastations produced by locusts, who sometimes make their appearance in clouds of vast extent. They seldom visit Europe in such swarms as formerly; yet in the warmer parts of it are still formidable. These insects are bred in the warm parts of Asia and Africa, from whence they have often taken their flight into Europe, and have committed terrible devastations. They multiply faster than any other animal in the creation, and are truly terrible in the countries where they breed. Some of them were seen in different parts of Britain in the year 1748, and great mischiefs were apprehended; but happily for us, the coldness of our climate and the humidity of our soil are very unfavourable to their production; so that, as they are only animals of a year's continuance, they all perish without leaving a young generation to succeed them.

When the locusts take the field, it is said they have a leader at their head, whose flight they observe, and pay a strict regard to all his motions. They appear at a distance like a black cloud, which, as it approaches, gathers upon the horizon, and almost hides the light of day. It often happens, that the husbandman sees this imminent calamity pass away without doing him any mischief; and the whole swarm proceeds

ceeds onward to settle upon some less fortunate country. In those places, however, where they alight, they destroy every green thing, stripping the trees of their leaves, as well as devouring the corn and grass. In the tropical climates they are not so pernicious as in the more southern parts of Europe. In the first, the power of vegetation is so strong, that an interval of three or four days repairs the damage; but in Europe this cannot be done till next year. Besides, in their long flights to this part of the world, they are famished by the length of their journey, and are therefore more voracious wherever they happen to settle. But as much damage is occasioned by what they destroy, as by what they devour. Their bite is thought to contaminate the plant, and either to destroy or greatly to weaken its vegetation. To use the expression of the husbandmen, *they burn whatever they touch*, and leave the marks of their devastation for three or four years ensuing. When dead, they infect the air in such a manner that the stench is insupportable.

Orosius tells us, that in the year of the world 3800, Africa was infested with a multitude of locusts. After having eaten up every thing that was green, they flew off, and were drowned in the sea; where they caused such a stench as could not have been equalled by the putrefying carcases of 100,000 men.

In the year 1650, a cloud of locusts was seen to enter Russia in three different places; and from thence they spread themselves over Poland and Lithuania in such astonishing multitudes, that the air was darkened and the earth covered with their numbers. In some places they were seen lying dead, heaped upon each other to the depth of four feet; in others, they covered the surface like a black cloth; the trees bent with their weight, and the damage which the country sustained exceeded computation.

In Barbary their numbers are formidable; and Dr. Shaw was a witness of their devastations there in 1724. Their first appearance was in the latter end of March,

when the wind had been southerly for some time. In the beginning of April, their numbers were so vastly increased, that, in the heat of the day, they formed themselves into large swarms that appeared like clouds, and darkened the sun. In the middle of May they began to disappear, retiring into the plains to deposit their eggs. In June the young brood began to make their appearance, forming many compact bodies of several hundred yards square; which afterwards marching forward, climbed the trees, walls, and houses, eating every thing that was green in their way. The inhabitants, to stop their progress, laid trenches all over their fields and gardens, which they filled with water. Some placed large quantities of heath, stubble, and such-like combustible matter, in rows, and set them on fire on the approach of the locusts. But all this was to no purpose; for the trenches were quickly filled up, and the fires put out, by the great numbers of swarms that succeeded each other. A day or two after one of these was in motion, others that were just hatched came to glean after them, gnawing off the young branches, and the very bark of the trees. Having lived near a month in this manner, they arrived at their full growth, and threw off their worm-like state, by casting their skins. To prepare themselves for this change, they fixed their hinder part to some bush or twig, or corner of a stone, when immediately, by an undulating motion used on this occasion, their heads would first appear, and soon after the rest of their bodies. The whole transformation was performed in seven or eight minutes time, after which they remained for a little while in a languishing condition; but as soon as the sun and air had hardened their wings, and dried up the moisture that remained after casting off their sloughs, they returned to their former greediness, with an addition both of strength and agility. But they did not long continue in this state before they were entirely dispersed. After laying their eggs, they directed their
course

course northward, and probably perished in the sea. In that country, however, the amazing fertility of the soil and warmth of the climate generally render the depredations of these insects of little consequence; besides that many circumstances concur to diminish their number. Though naturally herbivorous, they often fight with each other, and the victor devours the vanquished. They are the prey, too, of serpents, lizards, frogs, and the carnivorous birds. They have been found in the stomachs of the eagle and different kinds of owls. They are also used as food by the Moors; who go to hunt them, fry them in oil or butter, and sell them publicly at Tunis and other places.

From a paper published in the 18th volume of the Philosophical Transactions, we find, that in the year 1693 swarms of locusts settled in some parts of Wales. Two vast flights were observed in the air not far from the town of Dol-galken in Merionethshire; the others fell in Pembrokehire. From a letter published in the 38th volume of the same work, it appears that some parts of Germany, particularly the March of Brandenburg, &c. suffered considerable injury from the depredations of these animals. They made their appearance in the spring of the year 1732, from flights which had deposited their eggs in the ground the preceding year. They attacked and devoured the young spike of the wheat, and this chiefly by night, and thus laid waste many acres at a time beyond all hope of recovery. In the 46th volume of the same Transactions, we find a description of the ravages of these animals in Wallachia, Moldavia, Transylvania, Hungary, and Poland, in the years 1747 and 1748.

“ The first swarms entered Transylvania in August 1747; these were succeeded by others, which were so surprisingly numerous, that, when they reached the Red Tower, they were full four hours in their passage over that place; and they flew so close that they made a sort of noise in the air by the beating of their wings
against

against one another. The width of the swarm was some hundreds of fathoms, and its height or density may be easily imagined to be more considerable, inasmuch as they hid the sun, and darkened the sky, even to that degree, when they flew low, that people could not know one another at the distance of twenty paces; but whereas they were to fly over a river that runs in the valleys of the Red Tower, and could find neither resting-place nor food; being at length tired with their flight, one part of them lighted on the unripe corn on this side of the Red Tower, such as millet, Turkish wheat, &c. another pitched on a low wood, where, having miserably wasted the produce of the land, they continued their journey, as if a signal had actually been given for a march. The guards of the Red Tower attempted to stop their irruption into Transylvania by firing at them; and indeed, where the balls and shot swept through the swarm, they gave way and divided; but, having filled up their ranks in a moment, they proceeded on their journey. In the month of September some troops of them were thrown to the ground by great rains and other inclemency of the weather, and, thoroughly soaked with wet, they crept along in quest of holes in the earth, dung, and straw; where, being sheltered from the rains, they laid a vast number of eggs, which stuck together by a viscid juice, and were longer and smaller than what is commonly called an ant's egg, very like grains of oats. The females, having laid their eggs, die, like the silk-worm; and we Transylvanians found by experience, that the swarm which entered our fields by the Red Tower did not seem to intend remaining there, but were thrown to the ground by the force of the wind, and there laid their eggs; a vast number of which, being turned up and crushed by the plough in the beginning of the ensuing spring, yielded a yellowish juice.

“In the spring of 1748, certain little blackish worms were seen lying in the fields and among the bushes, sticking

licking together, and collected in clusters, not unlike the hillocks of moles or ants. As nobody knew what they were, there was little or no notice taken of them, and in May they were covered by the shooting of the corn sown in winter; but the subsequent June discovered what those worms were: for then, as the corn sown in spring was pretty high, these creatures began to spread over the fields, and become destructive to the vegetables by their numbers. Then at length the country people, who had slighted the warning given them, began to repent of their negligence: for as these insects were now dispersed all over the fields, they could not be extirpated without injuring the corn. At that time they differed little or nothing from our common grasshoppers, having their head, sides, and back, of a dark colour, with a yellow belly, and the rest of a reddish hue. About the middle of June, according as they were hatched sooner or later, they were generally a finger's length, or somewhat longer, but their shape and colour still continued. Towards the end of June they cast off their outward covering, and then it plainly appeared that they had wings, very like the wings of bees, but as yet unripe and unexpanded; and then their body was very tender, and of a yellowish green; in order to render themselves fit for flying, they gradually unfolded their wings with their hinder feet, as flies do; and, as soon as any of them found themselves able to use their wings, they soared up, and by flying round the others, enticed them to join them; and thus, their numbers increasing daily, they took circular flights of twenty or thirty yards square, until they were joined by the rest; and after miserably laying waste their native fields, they proceeded elsewhere in large troops. Wheresoever those troops happened to pitch, they spared no sort of vegetable: they ate up the young corn, and the very grass; but nothing was more dismal than to behold the lands in which they were hatched; for they so greedily devoured

voured every green thing thereon, before they could fly, that they left the ground quite bare.

“ Different methods are to be employed against them, according to their age and state; for some will be effectual as soon as they are hatched; others when they begin to crawl; and others, in fine, when they begin to fly; and experience has taught us here in Transylvania, that it would have been of great service to have diligently sought out the places where the females lodged; for nothing was more easy than carefully to visit those places in March and April, and to destroy their eggs or little worms with sticks or briars; or, if they were not to be beat out of the bushes, dunghills, or heaps of straw, to set fire to them; and this method would have been very easy, convenient, and successful, as it has been in other places; but in the summer, after they have marched out of their spring-quarters, and have invaded the corn-fields, &c. it is almost impossible to extirpate them without thoroughly threshing the whole piece of land that harbours them with sticks or flails; and thus crushing the locust with the produce of the land. Finally, when the corn is ripe, or nearly so, we have found, to our great loss, that there is no other method of getting rid of them, or even of diminishing their numbers, but to surround the piece of ground with a multitude of people, who might fright them away with bells, brass vessels, and all other sorts of noise. But even this method will not succeed till the sun is pretty high, so as to dry the corn from the dew: for otherwise they will either stick to the stalks, or lie hid under the grass; but when they happen to be driven to a waste piece of ground, they are to be beat with sticks or briars; and if they gather together in heaps, straw or litter may be thrown over them and set on fire. Now this method seems rather to lessen their numbers than totally destroy them; for many of them lurk under the grass or thick corn, and in the fissures of the ground, from the sun's heat: wherefore it

it is requisite to repeat this operation several times, in order to diminish their numbers, and consequently the damage done by them. It will likewise be of use, where a large troop of them has pitched, to dig a long trench, of an ell width and depth, and place several persons along its edges, provided with brooms and such-like things, while another numerous set of people form a semicircle that takes in both ends of the trench, and encompasses the locusts, and, by making the noise above-mentioned, drive them into the trench, out of which if they attempt to escape, those on the edges are to sweep them back, and then crush them with their broom and stakes, and bury them by throwing in the earth again. But when they have begun to fly, there should be horsemen upon the watch in the fields, who, upon any appearance of the swarm taking wing, should immediately alarm the neighbourhood by a certain signal, that they might come and fright them from their lands by all sorts of noise; and if, tired with flying, they happen to pitch on a waste piece of land; it will be very easy to kill them with sticks and brooms in the evening or early in the morning, while they are wet with the dew; or any time of the day in rainy weather, for then they are not able to fly. I have already taken notice that, if the weather be cold or wet in autumn, they generally hide themselves in secret places, where they lay their eggs, and then die: therefore great care should be taken at this time, when the ground is freed of its crop, to destroy them before they lay their eggs. In this month of September, 1748, we received certain intelligence that several swarms of locusts came out of Wallachia into Transylvania through the usual inlets, and took possession of a tract of land in the neighbourhood of Clausberry, nearly three miles in length, where it was not possible to save the millet and Turkish wheat from these devourers. I am of opinion, that no instance of this kind will occur in our history, except what some old men remember, and what we have experienced;

rienced; at least there is no account that any locusts came hither which did not die before they laid their eggs: however this is a known fact; that about forty years ago, some swarms came hither out of Wallachia, and did vast damage wherever they settled, but either left this country before the end of summer, or died by the inclemency of the weather."

As an appendix to the foregoing account, it is added by a correspondent from Vienna, that "a considerable number of locusts had also come within twenty leagues of that city, and that one column of them had been seen there, which was about half an hour's journey in breadth; but of such a length that, after three hours, though they seemed to fly fast, one could not see the end of the column."

In 1754, 5, 6, and 7, great devastations were committed in Spain by a species of locusts, of which we have the following description by Don Guillermo Bowles, published in Dillon's Travels through that country. "The locusts are continually seen in the southern parts of Spain, particularly in the pastures and remote uncultivated districts of Estramadura, but in general are not taken notice of, if not very numerous, as they commonly feed upon wild herbs, without preying upon gardens and cultivated lands, or making their way into houses. The peasants look at them with indifference while they are frisking about in the field, neglecting any measure to destroy them till the danger is immediate, and the favourable moment to remedy the evil is elapsed. Their yearly number is not very considerable, as the males are far more numerous than the females. If an equal proportion were allowed only for ten years, their numbers would be so great as to destroy the whole vegetative system. Beasts and birds would starve for want of subsistence, and even mankind would become a prey to their ravenous appetites. In 1754, their increase was so great from the multitude of females, that all La Mancha and Portugal were covered with them, and

and totally ravaged. The horrors of famine were spread even farther, and assailed the fruitful provinces of Andalusia, Murcia, and Valencia.

“ The amours of these creatures are objects of surprise and astonishment, and their union is such that it is difficult to separate them. When this separation is voluntary, after having lasted some hours, they are so exhausted, that the male retires immediately to the water for refreshment, where, losing the use of his limbs, he soon perishes, and becomes an easy prey to the fish; having given life to his offspring at the expence of his own. The female, disembarassed, though not without violent struggles, spends the remainder of her days in some solitary place, busy in forming a retreat under ground, where she can secure her eggs, of which she generally lays about forty, screening them by her sagacity from the intemperature of the air, as well as the more immediate danger of the plough or the spade.

“ These locusts seem to devour, not so much from a ravenous appetite, as from a rage of destroying every thing that comes in their way. It is not surprising that they should be fond of the most juicy plants and fruits, such as melons, and all manner of garden fruits and herbs, and feed also upon aromatic plants, such as lavender, thyme, rosemary, &c. which are so common in Spain, that they serve to heat ovens: but it is very singular, that they equally eat mustard-seed, onions, and garlic; nay even hemlock, and the most rank and poisonous plants, such as the thorn-apple and deadly night-shade. They will even prey upon crowfoot, whose causticity burns the very hides of beasts; and such is their universal taste, that they do not prefer the innocent mallow to the bitter furze, or rue to wormwood, consuming all alike, without predilection or favour, with this remarkable circumstance, that during the four years they committed such havock in Estramadura, the love-apple, or *Lycopersicon*

ficon solanum of Linnæus, was the only plant that escaped their rapacious tooth, and claimed a respect to its root, leaves, flowers, and fruit. Naturalists may search for their motives, which I am at a loss to discover; the more as I saw millions of them light on a field near Almaden, and devour the woollen and linen garments of the peasants, which were lying to dry on the ground. The curate of the village, a man of veracity, at whose house I was, assured me, that a body of them entered the church, and devoured the silk garments that adorned the images of the saints, not sparing even the varnish on the altars.

“ Out of curiosity to know the nature of so formidable a creature, I was urged to examine all its parts with the utmost exactness: its head is of the size of a pea, though longer, its forehead pointing downwards like the handsome Andalusian horse, its mouth large and open, its eyes black and rolling, added to a timid aspect not unlike a hare. In its two jaws it has four incisive teeth, whose sharp points traverse each other like scissars, their mechanism being such as to gripe or to cut. Thus armed, what can resist a legion of such enemies? After devouring the vegetable kingdom, were they, in proportion to their strength and numbers, to become carnivorous like wasps, they would be able to destroy whole flocks of sheep, even to the dogs and shepherd; just as we are told of ants in America, that will overcome the fiercest serpents.

“ The locust spends the months of April, May, and June, in the place of its birth: at the end of June its wings have a fine rose-colour, and its body is strong. Being then in their prime, they assemble for the last time, and burn with a desire to propagate their species: this is observed by their motions, which are unequal in the two sexes. The male is restless and solicitous, the female is coy, and eager after food, flying the approaches of the male, so that the morning is spent in the courtship of the one and the retreat
of

of the other. About ten o'clock, when the warmth of the sun has cleared their wings from the dampness of the night, the females seem uneasy at the forwardness of the males, who continuing their pursuit, they rise together five hundred feet high, forming a black cloud that darkens the rays of the sun. The clear atmosphere of Spain becomes gloomy, and the finest summer day of Estremadura more dismal than the winter of Holland. The rustling of so many millions of wings in the air, seems like the trees of a forest agitated by the wind. The first direction of this formidable column, is always against the wind, which if not too strong, the column will extend about a couple of leagues. The locusts then make a halt, when the most dreadful havoc begins; their sense of smell being so delicate, they can find at that distance a corn-field or a garden, and after demolishing it, rise again in pursuit of another: this may be said to be done in an instant. Each seems to have, as it were, four arms and two feet; the males climb up the plants, as sailors do the shrouds of a ship, and nip off the tenderest buds which fall to the females below.

"Many old people assured me, when so much mischief was done in 1754, it was the third time in their remembrance, and that they always are found in the pasture-grounds of Estremadura, from whence they spread into the other provinces of Spain. They are certainly indigenous, being of a different shape from those of the North or the Levant, as is evident in comparing them with such in the cabinets of natural history. The locust of Spain is the only one that has rose-coloured wings: besides, it is impossible they can come from any other part. From the north it is clear they do not, by the observation of so many ages; from the south they cannot, without crossing the sea, which is hardly possible by the shortness of their flight, and, like birds of passage, they would be known. I once saw a cloud of them pass over
Malaga,

Malaga, and move towards the sea, and go over it, for about a quarter of a league, to the great joy of the inhabitants, who concluded they would soon be drowned; but, to their disappointment, they suddenly veered about towards the coast, and pitched upon an uncultivated space surrounded with vineyards, which they soon after quitted. When once they appear, let the number demolished be ever so great, the proportion remaining is still too considerable; therefore, the only way to put an end to such a calamity, is to attack them before hand, and destroy their eggs, by which means they might be totally extirpated."

The ELEPHANT LOCUST, *Gryllus elephas*.

Thorax carinate, entire; body apterous. Inhabits Africa.

The SHORT LOCUST, *Gryllus succinctus*.

Keel and hind margin of the thorax and dorsal margin of the wing-cases yellow. Inhabits India.— See Plate II. fig. 11.

The CRESTED LOCUST, *Gryllus cristatus*.

Thorax crested, with a four-cleft ridge: wings variegated, brown at the lower margin. This is one of the largest species of locust yet known; and, together with some others of the larger kind, is made use of in some parts of the world as an article of food: they are eaten both fresh and salted, in which last state they are publicly sold in the markets of some parts of the Levant. The quantity of edible substance they afford is but small, especially in the male insects; but the females, on account of the ovaries, afford a more nutritious sustenance. It is well known that different interpretations have been sometimes given of the passage in the sacred writings in which John the Baptist is said to have fed on locusts and wild honey; and the word *ακριδας* has been supposed

posed to mean the young shoots of vegetables rather than locusts; but, since the fact is established, that these insects are still eaten by the inhabitants of the East, there seems not the least reason for admitting any other interpretation than the usually received one. Why should we wonder that the abstemious prophet, during his state of solitary seclusion from the commerce of the world, should support himself by a repast which is to be numbered, not among the luxuries of life, but merely regarded as a substitute for food of a more agreeable nature? We may also adduce in support of this idea the testimony of Hasselquist, who thus expresses himself on this very subject: "They who deny insects to have been the food of this holy man, urge, that this insect is an unaccustomed and unnatural food; but they would soon be convinced to the contrary, if they would travel hither, to Egypt, Arabia, or Syria, and take a meal with the Arabs. Roasted locusts are at this time eaten by the Arabs, at the proper season, when they can procure them; so that in all probability this dish had been used in the time of St. John. Ancient customs are not here subject to many changes, and the victuals of St. John are not believed unnatural here; and I was assured by a judicious Greek priest, that their church had never taken the word in any other sense; and he even laughed at the idea of its being a bird or a plant."

The crested locust is a highly beautiful animal; being of a bright red, with the body annulated with black, and the legs varied with yellow; the upper wings tessellated with alternate variegations of dark and pale green; the lower with transverse undulated streaks. The length of the animal from head to tail is about four inches; and the expanse of wings from tip to tip, when fully extended, hardly less than seven inches and a half.

The

The HONDURAS LOCUST, *Gryllus dux*.

Thorax carinate, rough; wing-cases green; lower wings rufous, spotted with blackish brown. Antennæ black; head yellowish; thorax greenish, with pale raised dots; wing-cases with yellow nerves; hind-margin of the wings brown; body and legs greenish. Inhabits South America.—Plate II. fig. 12, shews the perfect animal; fig. 13, the larva.

The SICKLY LOCUST, *Gryllus morbillosus*.

Thorax square, warty, red; wing-cases brown, dotted with white; wings rufous. Antennæ filiform, black. Inhabits the Cape.—This is shewn at fig. 14. Plate III.

The DOTTED LOCUST, *Gryllus punctatus*.

Thorax warty; wing-cases black, dotted with yellow; wings black. Abdomen green, with rufous rings. Inhabits India.—See fig. 15.

The ROUGH LOCUST, *Gryllus squarrosus*.

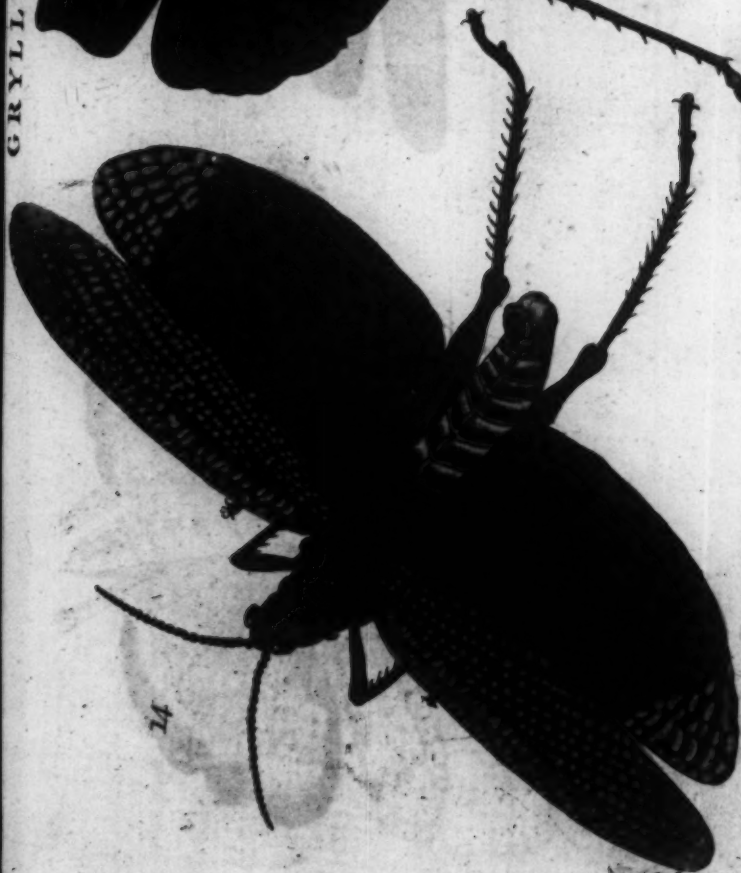
Thorax three-jointed, the joints spinous each side; wings red, dotted with black. Head and thorax dull green; first joint of the thorax two-spined, the hind spine tricuspidate, second joint with a tricuspidate spine, the third with many spines; wing-cases green, dotted with brown. Inhabits Africa.—See fig. 16.

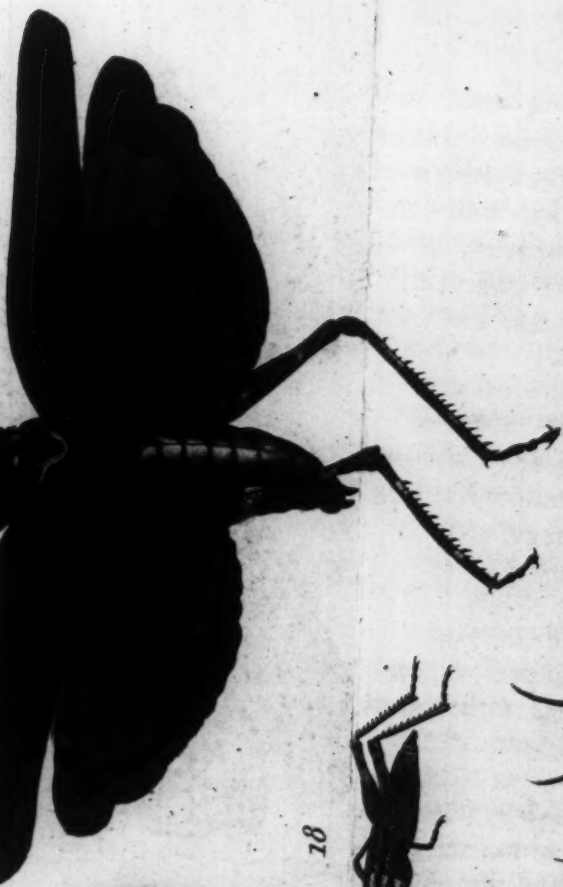
The COMMON LOCUST, *Gryllus migratorius*.

Thorax subcarinate, of a single segment; mandibles blue. Inhabits Tartary, and migrates in incredible swarms into various parts of Europe. The mischief these voracious creatures do, when they appear in vast legions, far exceeds the calamities occasioned by any other tribe of animals. By suddenly destroying all vegetation, they change the most fertile provinces into barren deserts, leaving behind them desolation,

GRYLLUS.

Plate III.





18



15



17

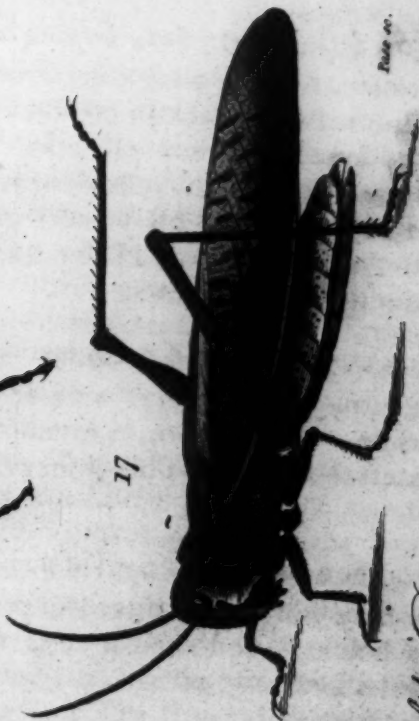


Plate 10.

Locusts of the fifth Division.

London, Published at the Art Library, No. 57, Abchurch Lane, by J. Wilson.

lation, and famine, and diseases. They have occasionally appeared in small flights in England, but have perished in a short time.

This was probably the species which constituted one of the plagues of Egypt. *Exod. x. 4.* Niebuhr speaks of them as follows: In Egypt I saw once a cloud of locusts, which was brought by a south wind from the deserts of Lybia; the locusts fell in prodigious quantities on the roofs of the houses, and in the streets of Kahira. I saw no more of them, till at Jidda, in November 1762, a large cloud of locusts was driven over the city by a west wind. The cloud came from the other side of the Arabic Gulf; and, therefore, many of the insects must have been drowned in their passage. In the month of July following, we found a small quantity near mount Sumara, which seemed to have spent the season in Arabia. These swarms often cross the Red Sea a second time, and return to Egypt, the upper part of which, adjoining to the deserts of Lybia, seems to be the cradle of these animals. I saw clouds of them in Persia, and Syria; where, in the quarter of Mosul, I found nests of these insects, which a careful police might in a great degree destroy. Small locusts, of the size of a fly, grow with amazing rapidity, and attain their natural size within a few days. There are undoubtedly various species of this insect, which have not as yet been sufficiently discriminated. Forskal calls the locust which infests Arabia *gryllus gregarius*, and thinks it to be different from that which is called by Linnæus *gryllus migratorius*, and which is a native of the deserts of Tartary, from which it passes through the neighbouring countries into Poland and Germany. The *gregarius* merits this denomination; for the locusts of this species appear to act in concert, and to live and travel in society. Those which remain after the departure of the great body are only irregular stragglers. The Arabians distinguish

tinguish several separate species of this insect, to which they give particular names. But these names are not expressive of any qualities in the nature of the animal; as they respect only the delicacy ascribed to its flesh. They give the name *muken* to the red locust, which is esteemed fatter and more succulent than any of the others; they likewise eat the light locust; but abstain from another, called *dubbe*, because it has a tendency to produce diarrhoea. All Arabians, whether living in their native country, or in Persia, Syria, and Africa, are accustomed to eat locusts. The Turks, on the contrary, have an aversion for this sort of food. If the Europeans express any thing of the same aversion, the Arabians then remind us of our fondness for oysters, crabs, and lobsters. A German, who had long resided in Barbary, assured us, that the flesh of this insect tasted like the small sardine of the Baltic Sea, which is dried in some towns of Holstein. We saw locusts caught, and put into bags, or on strings, to be dried, in several parts of Arabia. In Barbary, they are boiled, and then dried upon the roofs of the houses. The Bedouins of Egypt roast them alive, and devour them with the utmost voracity. We saw no instance of unwholesomeness in this article of food; Mr. Forskal was indeed told, that it had a tendency to thicken the blood, and to bring on melancholy habits. The Jews in Arabia are convinced, that the fowls, of which the Israelites ate so largely in the deserts, were only clouds of locusts; and laugh at our translators, who have supposed that they found quails where quails never were. The swarms of these insects darken the air, and appear at a distance like clouds of smoke. The noise they make in flying is frightful and stunning, like that of a water-fall. When such a swarm alights upon a field, it is wasted, and despoiled of its verdure. The pulse and date-trees suffer greatly from the locusts; but corn, either ripe or nearly so, is too hard for their

OF HEMIPTEROUS INSECTS. 211

their use, and they are obliged to spare it." This destructive insect is represented at fig. 17.

The VARIEGATED LOCUST, *Gryllus variegatus*.

Thorax with yellow lines; wing-cases green; wings blue. Antennæ black, with red rings; front red, with black spots. Inhabits America.—See fig. 18.

The NOISY LOCUST, *Gryllus vocans*.

Thorax carinate; wing-cases pale, with ocellar brown spots; wings ferruginous at the base. Head pale, testaceous; mandibles black; stemmata three, two gold ones above the antennæ, and another in the middle of the front; thorax ferruginous, the edge yellowish; wing-cases rounded. Inhabits New Holland.

The MUSICAL LOCUST, *Gryllus musicus*.

Thorax carinate; wing-cases black before, with a white band, behind grey varied with black. Head brown, palish at the sides, mandibles bluish; hind-thanks sanguineous, yellow at the base. Inhabits New Holland.

The GRASSHOPPER LOCUST, *Gryllus grossus*.

Thighs sanguineous; wing-cases greenish; antennæ cylindrical. Inhabits Europe.

The CAPTAIN LOCUST, *Gryllus centurio*.

Brown spotted with black; wings deep red, with black base margin, and fine undulated streaks.—Shewn at fig. 19.

The SOLDIER LOCUST, *Gryllus miles*.

Colour green, with two yellow stripes on the head, and two yellow spots on the thorax; elytra sword-shaped; wings with alternate stripes of reddish and black.

black. Inhabits America. This beautiful species is shewn at fig. 20.

FULGORA, THE LANTERN-FLY.

GENERIC characters, Head hollow, inflated, extended forward: antennæ short, seated beneath the eyes, consisting of two joints, the outer one larger and globular; snout elongated, inflected, four-jointed; legs formed for walking.

The name, Fulgora, is from the Latin *fulgeo*, to shine or glitter; as several of the species yield a considerable light in the dark, like the glow-worm; but the light proceeds from the head. In the twelfth edition of the *Systēma Naturæ* the number of species in this genus amounted only to nine: it has since been increased to the number of twenty-five. Of these most are exotic; only two are natives of our own island: and they are very small, and undistinguished by any shining quality.

The PERUVIAN LANTERN-FLY, *Fulgora lanternaria*.

Specific character, front or snout elongated, and straight; wing-cases richly variegated with a profusion of colours; on each wing a large lucid ocellate spot.

This is undoubtedly one of the most curious of insects: it is of a very considerable size, measuring nearly three inches and a half from the tip of the front to that of the tail, and about five inches and a half from wing's end to wing's end when expanded: the body is of a lengthened oval shape, roundish or subcylindric, and divided into several rings or segments: the head is nearly equal to the length of the rest of the animal, and is oval, inflated, and bent slightly upwards: the ground-colour is an elegant yellow, with a strong tinge of green in some parts, and marked with numerous bright red-brown variegations in the form of stripes and spots: the wings are very large, of a yellow colour, most elegantly varied

varied with brown undulations and spots, and the lower pair are decorated by a very large eye-shaped spot on the middle of each, the iris or border of the spot being red, and the centre half red and half semi-transparent white: the head or lantern is pale yellow, with longitudinal red stripes. This beautiful insect is a native of Surinam and many other parts of South-America, and during the night diffuses so strong a phosphoric splendor from its head or lantern, that it may be employed for the purpose of a candle or torch; and it is said that three or four of the insects, tied to the top of a stick, are frequently used by travellers for that purpose. The celebrated Madam Merian, in her work on the Insects of Surinam, gives a very agreeable account of the surprize into which she was thrown by the first view of the flashes of light proceeding from these insects. "The Indians once brought me," says she, "before I knew that they shone by night, a number of these lantern-flies, which I shut up in a large wooden box. In the night they made such a noise that I awoke in a fright, and ordered a light to be brought; not knowing from whence the noise proceeded. As soon as we found that it came from the box, we opened it; but were still much more alarmed, and let it fall to the ground in a fright, at seeing a flame of fire come out of it; and as many animals as came out, so many flames of fire appeared. When we found this to be the case, we recovered from our fright, and again collected the insects, highly admiring their splendid appearance."

Dr. Darwin, in a note to some lines relative to luminous insects, in his beautiful poem the Loves of the Plants, makes Madam Merian affirm that she drew and finished her figure of the insect by its own light. This, however, is a poetical licence. It may be proper to add, that this celebrated lady falls into a mistake in supposing that a species of Cicada, which she

she represents on the same plate with the lantern-fly, was its larva; and that it gradually was transformed into the Fulgora. This information indeed she merely gives as the popular report, but at the same time takes the liberty of representing the insect in its supposed half-complete state, with the head of the Fulgora, and the wings and body of the Cicada.

We have given two Plates to exemplify this species; one showing the Progreffive Generation of the Lantern-fly; the other, the Lantern-fly in its luminous state.

The CROWNED LANTERN-FLY, *Fulgora diadema*.

The head of this species, though not so resplendent and luminous as the preceding, is nevertheless extremely curious. The hood is extended almost half an inch above the eyes, in the shape of a crown; whence its specific name. It is decorated with many tubercles, like studded horns, on the sides, and trifid at the tip. The elytra, or wing-cases, next the body, are of a greenish hue, with some dusky red patches irregularly placed; and towards the extremity is a large patch of a dark yellow colour. The internal wings are black, but next the body are red, with some red spots scattered over the centre of them. This is a native of India, and very common at Cayenne.

The CHINESE LANTERN-FLY, *Fulgora candelaria*.

Front extended, ascending in the shape of a candle, and luminous. This is a much smaller species than the preceding, and is a native of China. It measures about two inches in length, and two and a half in breadth with the wings expanded: the body is oval, and the head produced into a long candle-shaped process: the colours are very elegant; the head and candle being of a fine reddish brown or purple, and covered with numerous white specks of a mealy appearance: the thorax is of a deep or orange yellow,
and

and the body black above, but deep yellow beneath: the wings are oval; the upper pair blackish, with very numerous and close-set green reticulations, dividing the whole surface into innumerable squares or marks, and are farther decorated by several yellow bars and spots: the under wings are orange-coloured, with broad black tips.

CICADA, THE FLEA LOCUST, or FROG HOPPER.

GENERIC characters, Beak inflected; antennæ setaceous; the four wings membranaceous and deflected; and the feet, in most of the species, of the jumping kind.

The species at present known are in number 286. The larvæ of several of this genus evacuate great quantities of a frothy matter upon the branches and leaves of plants, in the midst of which they constantly reside, probably for shelter against the search of other animals, to which they would become a prey. Nature has afforded this kind of defence to insects whose naked and soft bodies might otherwise very easily be injured; perhaps also the moisture of this foam may serve to screen them from the sultry beams of the sun. On removing the foam, we discover the larva concealed underneath; but it does not long remain uncovered. It soon emits fresh foam, that hides it from the eye of observation. It is in the midst of this foamy substance the larva goes through its metamorphosis into a chrysalis and perfect insect. Other larvæ, whose bodies are not so soft, run over plants without any manner of defence, and escape from insects that may hurt them by the nimbleness of their running, but especially of their leaping.

The chrysalids, and all the larvæ that produce them, differ little from each other, only that the former have the rudiments of wings, a kind of knob at the place where the wings will afterwards be in the perfect

perfect insect. As to other respects, the chrysalids walk, leap, and run over plants and trees; as do the larva and the frog-hopper which they are to produce. At length they throw off their teguments of chrysalids, slip their last slough, and then the insect appears in its utmost state of perfection. The male alone is then endowed with the faculty of singing, which it exercises not with its throat, but with an organ situated under the abdomen. Behind the legs of the male are observed two valvulæ, which, raised up, discover several cavities, separated by various membranes. The middle contains a scaly triangle. Two vigorous muscles give motion to another membrane, which alternately becomes concave and convex. The air, agitated by this membrane, is modified within the other cavities; and by the help of this sonorous instrument, he amorously solicits his female. By pulling the muscles of a frog-hopper lately dead, it may be made to sing. This insect begins its song early in the morning, and continues it during the heat of the noontide sun. Its lively and animated music is, to the country people, a presage of a fine summer, a plentiful harvest, and the sure return of spring. The cicadæ have a head almost triangular, an oblong body, their wings fastigiated, or in form of a roof, and six legs, with which they walk and leap briskly. In the females, at the extremity of the abdomen, are two large laminæ, between which is inclosed, as in a sheath, a spine, or lamina, somewhat serrated, which serves them for the purpose of depositing their eggs, and probably to sink them into the substance of those plants which the young larvæ are destined to feed upon.

The HORNED CICADA, *Cicada cornuta*.

Specific character, colour dark brown; on the thorax are two sharp horns, terminating in long spines on the sides. On the middle of the thorax rises a crest, which being elongated into a sinuous crooked horn,

horn, terminates in a sharp point: under this horn lies the escutcheon; the superior wings are dark and veined; the inferior are transparent, and much lighter: this dwells on the stems and leaves of fern and swallow-wort; leaps nimbly, and is not easy to catch.

The SPOTTED CICADA, *Cicada maculata*.

Colour black, spotted with yellow; legs not formed for leaping. The head is black, the eyes brown, and projecting; between them are two small yellow spots. the thorax is black, with four orange-coloured spots in a row, and behind them two others: the abdomen is black, consisting of seven annuli or rings; the anus, in the female, is furnished with a seta or bristle, through which she discharges her eggs, and introduces them into whatever she considers a proper nidus. The wings in both sexes are black, reticulated, and spotted with yellow: it is a large species, and inhabits China and Syria.

The NOISY CICADA, *Cicada stridula*.

This insect is hairy all over; the head is blunt, thick, and of a yellowish brown, with a black stripe down the middle; the abdomen is of a dark chocolate colour; the wings are membranaceous, and of a light brown, with dark chocolate-coloured bands spotted with white, and terminated all round with a white border: found at the Cape of Good Hope.

The RED-BELLIED CICADA, *Cicada cruenta*.

The head, eyes, and thorax, are yellowish brown; the abdomen is black, and annulated; the superior wings are red, tipped with yellow; the inferior are dull brown; all the under side of the insect is blood-red with a silvery down. It is a small species, inhabiting New Zealand.

The CLASSICAL CICADA, *Cicada plebeia*.

Specific character, scutell two-spined at the tip; upper wings with four anastomoses and six ferruginous lines.

This is the insect so often commemorated by the ancient poets, and so generally confounded by the major part of translators with the grasshopper. It is a native of the warmer parts of Europe, and particularly of Italy and Greece; appearing in the hotter months of summer, and continuing its shrill chirping during the greatest part of the day; generally sitting among the leaves of trees. These insects proceed from eggs deposited by the parent in and about the roots of trees, near the ground. They hatch into larvæ, which, when grown to their full size, are the *Tettigometræ* of the ancient writers; and after having continued in this state of larva near two years, cast their skins, and produce the complete insect. The ancients differ in their opinions relative to the *Cicadæ*. Virgil speaks of them as insects of a disagreeable and stridulous tone. On the contrary, Anacreon compliments them on their musical note, and makes the *Cicada* a favourite of Apollo. There is also a very pleasing and elegant tale, related by ancient authors, of two rival musicians alternately playing for a prize; when one of the candidates was so unfortunate as to break a string of his lyre; by which accident he would certainly have failed; when a cicada, flying near, happened to settle on his lyre, and by its own note supplied the defective string, and thus enabled the favourite candidate to overcome his antagonist. So remarkable was the event, that a statue was erected to perpetuate the memory of it, in which a man is represented playing on a lyre, on which sits a cicada. Notwithstanding these romantic attestations in favour of the cicada, it is certain that modern ears are offended rather than pleased with its voice,

OF HEMIPTEROUS INSECTS. 219

voice, which is so very strong and stridulous that it fatigues by its incessant repetition; and a single cicada hung up in a cage has been found almost to drown the voice of a whole company. We have before observed that the male cicada alone exerts this powerful note; the females being entirely mute: hence the old witticism attributed to Xenarchus the Rhodian:

“ Happy the cicadas’ lives,
Since they all have voiceless wives!”

The BLOODY CICADA, *Cicada sanguinolenta*.

General colour glossy black; but the elytra, or superior wings, have each three large spots of a beautiful crimson colour, viz. one at the base, close to the escutcheon, which is semi-circular; another round one, situate lower down, near the outward edge, and a third placed at a small distance from the extremity of the elytra, and forming a kind of half-moon, the points of which are turned to the upper part. The last spot coincides with its corresponding one on the other elytrum. Both the elytra are black at their extremities; and the inferior wings are dusky, tinged with a little red at their base. This is one of the handsomest species.

The FROTHY CICADA, OR FROG-HOPPER; *Cicada spumaria*.

Colour brown, often inclining to green; the head, thorax, and elytra, are finely dotted; on these last are seen two white spots, oblong and transverse, arising from the outer edge of the elytra, the one higher, the other lower, but not quite reaching to the inner edge, so that the bands by them formed across the elytra, or superior wings, are interrupted in the middle: the under parts are of a light brown. Its larva is constantly found enveloped in a mass of white froth adhering to the leaves and stems of vegetables. This froth, which is popularly known by the name of

cuckow-spittle, is found during the advanced state of summer, and is the production of the included larva, which, from the time of its hatching from the egg deposited by the parent insect, continues, at intervals, to suck the juices of the stem on which it resides, and to discharge them from its vent in the form of very minute bubbles, and by continuing this operation, completely covers itself with a large mass of froth; which is sometimes so overcharged with moisture, that a drop may be seen hanging from its under surface. The included larva, or pupa, (for no material difference can be observed between these two states,) when arrived at its full growth, is about the fifth of an inch in length, of an oval shape, with broad head and thorax, and slightly pointed abdomen: the trunk or sucker with which it extracts the sap of the plant, may be observed by examining the under part of the thorax, where it will be seen pressed down in a straight direction from the head. When the time arrives in which the animal is to undergo its change into the complete insect, it ceases to absorb any longer the juices of the plant and to discharge the protecting froth, which, at this period, forms a vaulted canopy over the insect, instead of entirely investing it as before: the skin of the larva is gradually thrown off, and the animal in its complete form emerges from its concealment. If disturbed, it nimbly springs to a great distance, and is commonly known by the name of the *frog-hopper*, from some fancied resemblance to the colour and shape of that animal in miniature. These insects breed during the month of September, and towards the beginning of October deposit their eggs, which are not hatched till the succeeding spring.

The WOOLLY CICADA, *Cicada lanata*.

Specific character; tail woolly. The head is of a dull brown, with a moveable horn like a bristle, which the insect can raise at pleasure; the wings are reddish

OF HEMIPTEROUS INSECTS. 221

reddish brown, and transparent, at the extremities; but from thence to the abdomen they are of a fine mazarine blue, spotted with white; the abdomen, corslet, and thorax, partake of the same blue colour. It is found in North America and the West Indies.

The GREEN CICADA, *Cicada viridis*.

Colour, deep green, but mostly transparent: the thorax and escutcheon are green; the head is yellow, with two black dots strongly marked upon the upper part, and a few small ones on the sides. There are likewise two black puncta discernible on the escutcheon.

NOTONECTA, THE BOAT-FLY.

GENERIC characters, Snout inflected; antennæ shorter than the thorax; wings four, folded crosswise, coriaceous on the upper half; hind legs hairy, formed for swimming.

These insects have obtained their name from the singular manner in which they swim on the back, presenting the belly uppermost. This situation seems admirably fitted for the creature's manner of feeding; which is said to be on the under side of plants that grow on the surface of the water; the animal, by having its mouth turned upwards, is capable of taking its food with greater convenience: nor are its motions in the least impeded by this awkward posture; on the contrary, it is very nimble, diving down instantaneously, when it perceives danger, and rising again to the surface, the two hind legs all the while serving for paddles. This genus includes 17 species, of which three are found in England.

The GREY BOAT-FLY, *Notonecta glauca*.

This is a very common aquatic insect, inhabiting stagnant waters, and generally measuring about three parts of an inch in length. Its colour is grey-brown,
and

and the upper wings are marked along the edges by a row of minute black specks. This insect is usually seen swimming on its back, in which situation it bears a most striking resemblance to a boat in miniature, the hind-legs acting like a pair of oars, and impelling the animal at intervals through the water. It preys on the smaller inhabitants of the water, and flies only by night.

The STRIATED BOAT-FLY, *Notonecta striata*.

Much smaller than the preceding, not measuring more than a quarter of an inch in length. It is of a yellowish grey colour, with numerous transverse undulated black lines or streaks: it is found, like the preceding, in stagnant waters.

NEPA, THE WATER SCORPION.

GENERIC characters, Snout inflected, antennæ short. Wings four, cross-complicate, coriaceous on the upper part. Fore-feet cheliform, the rest formed for walking.

This genus, like the preceding, is aquatic, inhabiting stagnant waters, and preying on the smaller water-insects, &c. There are 14 species, three of which are found in Great Britain. All these dwell in the water, both in the state of larva and chrysalids. The eggs of the water scorpion are also deposited in that element; they are of an oblong shape, and have at one extremity two or more vibrifera, the only part of them which is seen, the rest being sunk and concealed in the stalk of a bulrush, or other water plant. These plants may be removed, and placed in water near the naturalist, who may thus have an opportunity of seeing them hatched and coming forth animated larvæ immediately under his eye. The water scorpions, when thus excluded from the eggs, remain for some time in the state of worms, in the place of their nativity. When they arrive at
their

their full size, and are metamorphosed into complete insects, they are sometimes an inch in length, and nearly half as broad. The antennæ appear in the usual place of the fore legs; they are armed with a forceps, well adapted to the rapacious purposes to which they are applied. The nepæ are of all animals the most tyrannical; they destroy, like wolves among sheep, twenty times as many as their hunger requires. If one of them is placed in a basin of water with thirty or forty worms of the libellula tribe, each as large as itself, it will destroy them all in a very short space, getting on their backs, and piercing them through the body with its rostrum. These animals, though they live upon the water by day, are capable of taking long flights from one pool to another in quest of food: this they are probably often obliged to attempt, from the fierceness of their manners, by which the insects in their vicinity must be soon destroyed. Though so formidable to other creatures, they are nevertheless haunted by a little louse, which probably repays the injuries which the water scorpion so frequently commits upon others.

The LARGE WATER SCORPION, *Nepa Grandis*.

This insect, which very far surpasses in size all the European animals of the genus, is a native of Surinam and other parts of South-America, often measuring more than three inches in length. Its colour is a dull yellowish brown, with a few darker-yellow shades or variegations: the under-wings are of a semi-transparent white colour, and the abdomen is terminated by a short tubular process. Madam Merian represents this species, in her Surinam insects, as preying on tadpoles and young frogs.

The COMMON WATER SCORPION, *Nepa cinerea*.

This is a very frequent inhabitant of stagnant waters in our own country, measuring about an inch in length,

length, and appearing, when the wings are closed, entirely of a dull brown colour; but, when the wings are expanded, the body appears of a bright red colour above, with a black longitudinal band down the middle: and the lower wings, which are of a fine transparent white, are decorated with red veins. From the tail proceeds a tubular bifid process or style, nearly of the length of the body, and which appears single on a general view, the two valves of which it consists being generally applied close to each other throughout their whole length. The animal is of slow motion, and is often found creeping about the shallow parts of ponds, &c. In the month of May it deposits its eggs on the soft surface of the mud at the bottom of the water: they are of a singular shape, resembling some of the crowned seeds, having an oval body, and an upper part surrounded by seven radiating processes or curved spines. The young, when first hatched, are not more than the eighth of an inch in length. This flies only by night, when it wanders about the fields in the neighbourhood of its native waters. The larvæ and pupæ differ in appearance from the complete insect in having only the rudiments of wings, and being of a paler or yellower colour.

The LINEATED WATER SCORPION, *Nepa linearia*.

An insect of a highly singular aspect, bearing a distant resemblance to some of the smaller insects of the genus Mantis. It measures about an inch and half from the tip of the snout to the beginning of the abdominal style or process, which is itself of equal length to the former part, and the whole animal is extremely slender in proportion to its length: the legs also are long and slender, and the chelæ or fore-legs much longer in proportion than those of the preceding species. The colour of the animal is dull yellowish brown, the back, when the wings are expanded, appearing

OF HEMIPTEROUS INSECTS. 225

pearance of a brownish red, and the under wings white and transparent. It inhabits the larger kind of stagnant waters, frequenting the shallower parts during the middle of the day, when it may be observed to prey on the smaller water insects, &c. Its motions are singular; often striking out all its legs in a kind of starting manner at intervals, and continuing this exercise for a considerable time. The eggs are smaller than those of the *Nepa cinerea*, of an oval shape, and furnished with two processes or bristles divaricating from the top of each.

The BUG-LIKE WATER SCORPION, *Nepa cimicoidis*.

This species bears a resemblance both to the preceding and following genus. It is allied to the *Notonecta* by having the hind legs formed for swimming briskly, and furnished with an edging of hairs on the inner side: it also bears a resemblance to the generality of the *Cimices*, or bugs, in its broadly ovate shape. The thorax and upper wings are pale brown; the lower wings transparent white, and the back, which appears only when the wings are expanded, is of a fine bluish black: the sides of the abdomen are serrated: the under surface is of a pale yellowish brown, with blue-green thorax: the fore-feet, or chelæ, are very short, and the abdomen is destitute of any lengthened process. This insect is less common than the preceding, but is found in similar situations.

CIMEX, THE BUG.

GENERIC characters, Rostrum inflected; antennæ are longer than the thorax; wings four, folded together crosswise; the upper ones coriaceous from their base towards their middle; back flat; thorax margined; feet formed for running.

This genus is divided into different sections, the whole number of species being no less than 825. The common bed-bug has no wings; but the field-

bugs have all wings, and inhabit plants as various as their shape and colour. In their larva state they are very active, and differ but little from the perfect insect except by the want of wings; they run over plants, grow and change to chrysalids, without appearing to undergo any material difference. They have only rudiments of wings, which the last transformation unfolds, and the insect is then perfect. In the two first stages they are unable to propagate their species. In their perfect state, the female, secundated, lays a great number of eggs, which are often found upon plants, placed one by the side of another; many of which, viewed through a magnifier, present singular varieties of configuration. Some are crowned with a row of small hairs, others have a circular fillet, and most have a piece which forms a cap; this this piece the larva pushes off when it forces open the egg. Released by nature from their prison, they overpread the plant on which they feed, extracting, by the help of the rostrum, the juices appropriated for their nourishment: even in this state, the larvæ are not all so peaceably inclined; some are voracious in an eminent degree, and spare neither sex nor species they can conquer. In their perfect state they are mere cannibals, glutting themselves with the blood of animals; they destroy caterpillars, flies, and even the coleopterous tribe, whose hardness of elytra one would imagine was proof against their attacks; yet they have fallen an easy prey to the sharp piercing nature of the rostrum of the bug, and the uncautious naturalist may experience a feeling severity of its nature.

The COMMON BED-BUG, *Cimex lectularius*.

Specific character, no wings. To give a particular description of an animal so well known would be superfluous: it may be sufficient to observe, that it is of an oval shape, about the sixth of an inch in length,

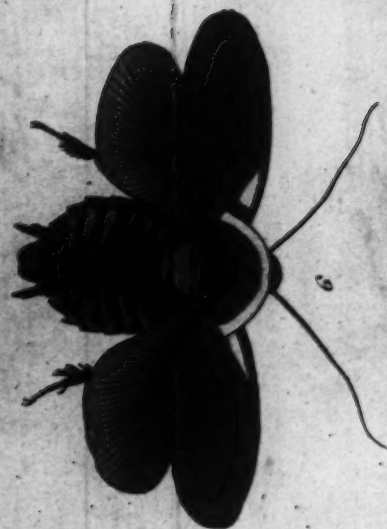
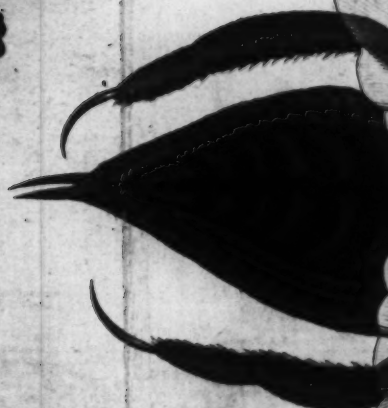
OF HEMIPTEROUS INSECTS. 227

length, of a very compressed or flat form, and of a reddish brown colour. It is easily destroyed by pressure, being of a very tender nature, and when bruised diffuses a highly unpleasant smell. In the beginning of summer it deposits its eggs, which are very small, white, and of an oval shape, each standing on a kind of short pedicle or footstalk, in the cavities of walls or wood-work, and from these are hatched, in the course of three weeks, the young, which differ from the parent insect in no other respect than size and colour, being at first much paler than when more advanced in their growth; not arriving at their full size in less than about three months. They live entirely by suction, employing for this purpose their sharp and fine trunk or proboscis, which is carried in a straight direction beneath the breast. It is probable that this insect, like the gnat and some others, infuses some irritating fluid into the wound it makes, when it sucks the blood of the animal it attacks, since the swelling which it causes is often very considerable, and attended with severe itching. During the winter months these animals secrete themselves behind walls, wainscoting, or any neglected places, where they are capable of supporting the most intense frost without injury, and on the return of warm weather again emerge from their concealment. When confined in a box for any length of time, they will often attack and destroy each other. It is affirmed by Scopoli, whose observations are, in general, distinguished by great accuracy, that this insect, in the duchy of Carniola, is, at certain seasons, furnished with wings, though apterous in other parts of Europe. Mr. Baker, in his "Microscope made easy," informs us that the bug is one of the best subjects for exhibiting a microscopic view of the circulation of the blood. "In the legs of small bugs (says this writer) the circulation is remarkably visible, together with an extraordinary vibration of the vessels, which I have ne-

ver observed in any other creature : in these too, if clear, as they may sometimes be found, the wonderful motions of all the internal parts will afford an agreeable entertainment to the curious."

The bug, now so frequent a nuisance in the metropolis as well as in most parts of the country, is said to have been in a great degree unknown in England in the days of our ancestors. It is indeed affirmed in Southall's Treatise of Bugs, (Lond. 1730. 8vo.) that it was scarcely known in England before the year 1670, when it was imported among the timber used in rebuilding the city of London after the great fire of 1666. That it was however known much earlier is hardly to be doubted, though probably far less common than at present; since Mouffet informs us, that Dr. Penny, one of the early compilers of that History of Insects, relates his having been sent for in great haste to Mortlake in Surry to visit two noble ladies who imagined themselves seized with the usual symptoms of the plague; but on Penny's demonstrating to them the true cause of their complaint, viz. having been bitten by these insects, and even detecting them in their presence, the whole affair was turned into a jest. This was in the year 1583.

The methods employed for destroying or expelling house-bugs are various; as oil of turpentine, the smoke of corn-mint, of narrow-leaved wild cress, of bug-bane, herb-robert, the reddish agaric, mustard, Guinea pepper, peat, or turf, &c. Mr. Southall, whose book we have quoted, and who practised the art of destroying these insects in houses, affirms with confidence that the application of his liquor (the receipt of which he obtained from an old negro in America) to the holes or crevices of places containing them, immediately caused them to come out in great numbers, and immediately die. "On the application (says he) of this liquor, at all seasons of the year, they will come out, and immediately die before



Different Species of the Linnaean or Bug.

Engraved by the artist, and colored by J. M. B. M.

Linnaean

CIMEX.



before your face." At present we know of nothing so effectual as a mixture of corrosive sublimate (*hydrargyrus muriatus*) and lard, in the proportion of half an ounce of the former to six ounces of the latter. The sublimate should be first rubbed extremely fine in a marble mortar, adding a few drops of common oil, till its particles are minutely divided. The lard should then be added by little and little, till the whole is well mixed; and lastly, as much more oil as will make the mixture of the consistence of a very thick paint. The bedstead is to be then taken to pieces, brushed in the joints, and some of this unguent applied with a small brush all over, and likewise between every crevice that can be discovered. Some recommend a mixture of spirit of wine, oil of turpentine, and camphor; but these ingredients evaporate quickly, and, though destructive to all the bugs that are alive, this liquid does not prevent the nits from being hatched. Beds infested with bugs should be taken down and dressed every year for at least two or three years, after which it is probable they will no longer need it.

The annexed large Engraving contains figures of the most curious species of this genus.

Fig. 1. represents the *Cimex lectularius*, or common house-bug, just described. It is said to be the only one of this genus that is for ever destitute both of elytra and wings.

Fig. 2. is the *Cimex annulatus*, of a light brown colour, and oval shape. This is magnified; being in nature about the size of a large cherry-stone. The thorax has two annular black bands crossing it from side to side; close to which the escutcheon joins, which is very large, entirely covers the abdomen, and is marked all over with different shaped spots like eyes; whence it has been named the *argus*: it is a native of Sierra Leone, in Africa.

Fig. 3. *Cimex corticatus*; a very curious species,
drawn

drawn to its natural size. It is singularly thin and flat, and near an inch long; the eyes are small and round; it is furnished with a beak that extends to the middle of the abdomen; the escutcheon is large and triangular; the elytra or wing cases are entirely opaque and small, not covering the abdomen, which appears denticulated, and of a yellowish green; the head, corset, and elytra, are of a beautiful fawn-colour inclining to red: it is found at Brasil.

Fig. 4. *Cimex cristatus*, a very singular insect, somewhat resembling a spider. It is near an inch and a quarter long; the head very small; the neck long and slender; the thorax is small and black, the escutcheon large and crested, rising high, and dentated like the comb of a cock. The whole insect is of a fine ferruginous brown, except a large oval spot on the extremity of each elytrum, which is of a beautiful gold green: it is a native of the island of St. Vincent.

Fig. 5. *Cimex crenulatus*, from Antigua; about three quarters of an inch long; the head is small, and red, striped with black; eyes round and projecting; the thorax is red, marked with black; the escutcheon greenish black; the elytra the same except at the ends, which are dark brown; the wings are a light transparent straw-colour; down the centre of the abdomen passes a broad line of a shining bluish green; the sides red, indented with lines of black.

Fig. 6. *Cimex papillofus*; a large and handsome species, very thick, gibbous at the stern, and much compressed: the head is small, the thorax rising high and large, the escutcheon triangular, all of a bright yellowish olive colour; the elytra are the same, except at the tips, which are membranaceous and transparent; the inner wings are nearly the same, but of a brighter colour. The abdomen is of a dark purple, annulated, and dentated at the sides, which have a bright coppery gloss; the anus terminates in two angular

gular points, with a small thorn or cornicle on each side: it measures upwards of an inch, and is a native of China.

Fig. 7. *Cimex Druriae*, so named from Mr. D. Drury, author of the Illustration of Exotic Insects, who first introduced it; it is an ugly species, about three quarters of an inch long: the body is large, squat, and wholly of a deep scarlet, except two broad transverse bands of black which cross the abdomen, and four round spots, two upon the thorax, about the size of tares, and two just above anus, but smaller; the wing-cases or elytra are of a dark olive-colour; and the inner wings are the same, but membranaceous, and somewhat lighter: this is a native of South America, and is reckoned a very rare and curious insect.

Fig. 8. *Cimex Senegalensis*, a large species, found in Senegal, measuring in its expanded state, from wing to wing, near two inches: the head is dark mazarine blue; the thorax cream-colour, charged with two oblong square blue-green spots, which gives it the appearance of being toothed, or like the letter m inverted; the escutcheon is of a triangular form, and of the same deep blue-green, with the abdominal point terminated by cream-colour; the elytra are blue-green half way from the chest, and then fringed with a yellowish brown; the inferior wings are membranaceous, and nearly white; the abdomen is red, annulated with black, obtuse, dentated at the sides, and bordered with round black spots.

Fig. 9. *Cimex aurantius*, the general cast of the insect being an aurora or golden colour. It ranks among the handsomest of the bugs: the head and thorax are of an auburn brown, surrounded with a cream-coloured margin on the anterior side, in the form of a crescent; at the points of which an angular return is made, of the same colour, which enters the elytra in shape of a spine; the superior and inferior

terior wings are very similar, the latter being the lightest; the abdomen is large, broad, and annulated with chestnut belts on a golden ground; the anus is gibbous, terminating in a blunt chestnut protuberance, with a spine on each side: it is a native of India, and is found in the islands of Java and Ceylon; and measures full two inches in its alar extent.

Fig. 10. *Cimex paradoxus*, the leaf insect, a very peculiar species discovered by Dr. Sparman at the Cape. He observed it as at noon-tide he sought for shelter among the branches of a shrub from the intolerable heat of the sun. "Though the air," says he, "was extremely still and calm, so as hardly to have shaken an aspen leaf, yet I thought I saw a little withered, pale, crumpled, leaf, eaten as it were by caterpillars, fluttering from the tree. This appeared to me so very extraordinary, that I thought it worth my while suddenly to quit my verdant bower in order to examine it: and I could scarcely believe my eyes, when I saw a live insect, in shape and colour resembling the fragment of a withered leaf, with the edges turned up and eaten away, as it were, by caterpillars, and at the same time all over beset with prickles. Nature, by this peculiar form, has certainly well defended and concealed, as it were in a mask, this insect from birds and its other foes; in all probability with a view to preserve it, and employ it for some important office in the system of her economy."

Fig. 11. *Cimex Merianæ*, thus named from Madame Merian, who first discovered this frightful insect at Surinam, and figured it from the life in her inimitable collection, from which our figure is taken. It is the largest known species of the cimex tribe, measuring three inches and a half from head to tail, and near six inches in alar extent. It is of a rich ferruginous brown colour, armed with a single sharp curved spine on the head, and another at the anus; eyes black and very prominent; two large dark-brown

brown spots on the thorax, about the size of pease; two others more oblong behind; and others of various forms and sizes on the fore-legs; the elytra are reticulated with white, and are very thick and strong; the interior wings are membranaceous, and of a delicate straw-colour.—Fig. 12, is the larva of this gigantic cimex, which differs but little from the perfect insect, except in the want of its wings. It is the same with the larvæ of all the bug species; the body being nearly the same in their creeping or caterpillar state, as when they have protruded their elytra and their wings. This is not only the largest, but the most destructive and voracious, of the genus, attacking and devouring, in its creeping state, toads, frogs, lizards, aquatic insects, and even fish; and in its winged state, preying upon reptiles, birds, and the larger animals, and even on the weaker individuals of its own family.

MACROCEPHALUS, THE LONG-HEAD.

THIS genus was erected for a single species, which might as well have been included among the Cimices. The generic characters are, Snout inflected; sheath one-valved, three-jointed, and furnished with three bristles; antennæ projecting, very short, clavate; head oblong, cylindrical above; scutel as long as the abdomen, depressed and membranaceous.

The BUG-LIKE LONG-HEAD, *Macrocephalus cimicoides*.

This insect is described in the Trans. of the Stockholm Academy, vol. viii. for 1787. It is somewhat less than the Cimex erosus. The body is of a ferruginous-grey-colour; the scutel pale ash with a yellow rigid spot; under wings violet. Inhabits North America.

APHIS, THE PLANT-LOUSE.

GENERIC characters, Snout inflected; antennæ or feelers longer than the thorax; the wings four, erect, or they are wanting; the feet are of the ambulatory kind; and the belly often ends in two horns, from which is ejected that most delicate juice called *honey-dew*. There are 72 species of the aphis, all of them inhabitants of particular plants from which their trivial names are taken: and it is probable that many more remain still to be added, as many of the same kind of plants are found to support two or three quite different sorts of aphides.

The extraordinary nature of these insects for some time excited the wonder and attention of naturalists. They were long ranked among the animals which had been classed with the true androgynes spoken of by Mr. Breynius: for, having never been seen in coitu, it was hastily concluded that they multiplied without copulation. This, however, was but a surmise: but this surmise was believed and adopted by Mr. Reaumur: and, though he supported it by some observations peculiar to himself, the question remained still undecided, until Mr. Bonnet cleared it up in the affirmative, by shutting up a young aphis at the instant of its birth, in the most perfect solitude, which yet brought forth in his sight ninety-five young ones. The same experiment being made on one of the individuals of this family, that had been tried with its chief, the new hermit soon multiplied like its parent; and one of this third generation, in like manner brought up in solitude, proved no less fruitful than the former. Repeated experiments, in this respect, as far as the fifth or sixth generation, all uniformly presenting the observer with fecund virgins, were communicated to the Royal Academy of Sciences; when an unforeseen and very strange suspicion, imparted by Mr. Tremblay to Mr. Bonnet, namely, that one copulation of these

these insects might serve for several generations, engaged him anew in a series of still more painful experiments than the foregoing. Mr. Bonnet now reared to the amount of the tenth generation of solitary aphides, and had the patience to keep an account of the days and hours of the births of each generation. In short, it was discovered, that they are really distinguished by sexes: that there are males and females amongst them, whose amours are the least equivocal of any in the world; that the males are produced only in the tenth generation, and are but few in number: that these, soon arriving at their full growth, copulate with the females: that the virtue of this copulation serves for ten generations: that all these generations, except the first (from the fecundated eggs) are produced viviparous; and all the individuals are females, except those of the last generations, among whom some males make their appearance, to lay the foundations of a fresh series. These circumstances have been confirmed by other naturalists. In particular, we have a curious and accurate detail of them by Dr. Richardson of Rippon, in the *Philosophical Transactions*, vol. xi. art. 22.

The young, immediately after being protruded from the mother, are always of a paler colour than the parent: they have then the entire use of their limbs, and go in quest of food. All the different kinds cast their skin; and it is after these developements that such of them as have wings obtain these parts; but in this respect they are subject to great variation, there being some males and some females that never have wings; again there are some females that become winged, while others of the same species do not.

In the quality of the excrement voided by these insects there is something very extraordinary; and upon this subject, as well as for other recent particulars, we shall quote a paper in the sixth volume of the *Linneæan Transactions*, furnished by the late ingenious

Mr. Curtis. " Were a person (says Mr. C.) accidentally to take up a book in which it was gravely asserted that in some countries there were certain animals which voided liquid sugar, he would soon lay it down, regarding it as a fabulous tale, calculated to impose on the credulity of the ignorant;—and yet such is literally the truth. The superior size of the *Aphis falicis* will enable the most common observer to satisfy himself on this head. On looking steadfastly for a few minutes on a groupe of these insects while feeding on the bark of the willow, one perceives a few of them elevate their bodies, and a transparent substance evidently drop from them, which is immediately followed by a similar motion, and discharge like a small shower from a great number of others. At first I was not aware that the substance thus dropping from these animals at such stated intervals was their excrement, but was convinced of its being so afterwards; for on a more accurate examination I found it proceed from the extremity of the abdomen, as is usual in other insects. On placing a piece of writing-paper under a mass of these insects, it soon became thickly spotted: holding it a longer time, the spots united from the addition of others, and the whole surface assumed a glossy appearance. I tasted this substance, and found it as sweet as sugar. I had the less hesitation in doing this, having observed that wasps, ants, flies, and insects without number, devoured it as quickly as it was produced. Were it not for these, it might no doubt be collected in considerable quantities; and, if subjected to the processes used with other saccharine juices, might be converted into the choicest sugar or sugar-candy.

" In the height of summer, when the weather is hot and dry, and aphides are most abundant, the foliage of trees and plants (more especially in some years than others) is found covered with and rendered glossy by a sweet clammy substance known to persons
resident

resident in the country by the name of *honey-dew*: they regard it as a sweet substance falling from the atmosphere, as its name implies. The sweetness of this excrementitious substance, the glossy appearance it gave to the leaves it fell upon, and the swarms of insects this matter attracted, first led me to imagine that the honey-dew of plants was no other than this secretion,—which farther observation has since fully confirmed. Others have considered it as an exudation from the plant itself. But that it neither falls from the atmosphere, nor issues from the plant itself, is easily demonstrated. If it fell from the atmosphere, it would cover every thing indiscriminately, whereas we never find it but on certain living plants and trees.

We find it also on plants in stoves and green-houses covered with glass. If it exuded from the plant, it would appear on all the leaves generally and uniformly; whereas its appearance is extremely irregular, not alike on any two leaves of the same tree or plant, some having none of it, and others being covered with it but partially. But the phenomena of the honey-dew, with all their variations, are easily accounted for by considering the aphides as the authors of it. That they are capable of producing an appearance exactly similar to that of the honey-dew has already been shewn. As far as my own observation has extended, there never exists any honey-dew but where there are aphides; such however often pass unnoticed, being hid on the under-side of the leaf. Wherever honey-dew is observable about a leaf, aphides will be found on the under side of the leaf or leaves immediately above it, and under no other circumstances whatever. If by accident any thing should intervene between the aphides and the leaf next between them, there will be no honey-dew on that leaf. Thus then we flatter ourselves to have incontrovertibly proved that the aphides are the true and only source of the honey-dew.

“ In

“ In most seasons the natural enemies of the aphides are sufficient to keep them in check, and to prevent them from doing any essential injury to plants in the open air. But seasons sometimes occur, very irregularly indeed, on an average perhaps once in four or six years, in which they are multiplied to such an excess, that the usual means of diminution fail in preventing them from doing irreparable injury to certain crops. In severe winters we have no doubt that aphides are very considerably diminished: in very mild winters we know they are very considerably increased; for they not only exist during such seasons, but continue to multiply. Their enemies, on the contrary, exist, but do not multiply, at least in the open air, during such periods; and thus the aphid gets the start of them, and acquires an ascendancy, which once acquired is not easily overcome by artificial means, upon a large scale at least, in the open air. Vain would be the attempt to clear a hop-garden of these pernicious vermin, or to rescue any extensive crop from their baneful effects. Violent rains attended with lightning have been supposed to be very effectual in clearing plants of them; but in such case more is to be attributed to the plants being refreshed and strengthened, and made to grow, by the rain, of which they stood in need, than to any destruction of the aphides themselves, which, on accurate examination, will be found to be as plentiful after such rains as they were before; nor is wet so injurious to these insects as many imagine, as is evident from the following experiment: On the 12th of May 1799, I immersed in a glass of water the footstalk of a leaf of considerable length, taken from a stove-plant beset with aphides of a dark lead-colour, which were feeding on it in great numbers. On immersion they did not quit the stalk, but immediately their bodies assumed a kind of luminous appearance from the minute bubbles of air which issued from them. They were put
under

under water at a quarter past six in the evening, and taken out at a quarter past ten the next morning, having continued immersed sixteen hours. On placing them in the sunshine, some of them almost immediately shewed signs of life, and three out of four at least survived the immersion. One of the survivors, a male, very soon became winged, and another, a female, was delivered of a young one. Many years before this experiment, with a view to destroy the aphides, which infested a plant in my green-house, I immersed one evening the whole plant, together with the pot in which it grew, in a tub of water. In the morning I took out the plant, expecting with certainty to find every aphis dead; but to my great surprise they soon appeared alive and well: and thus in addition to the other extraordinary phenomena attendant on these insects, we find that they are capable of resisting the effects of immersion in water for a great length of time. When taken from the plant on which they feed and kept under water, they do not survive so long.

“ Though no mode of destroying aphides will perhaps ever be devised on a large scale in the open air by artificial means, we can accomplish it most effectually when they infest plants in green-houses and frames, or in any situation in which we can envelope them for a certain time in clouds of smoke. Powders or liquids, however fatal to aphides, must ever be ineffectual, from the trouble and difficulty of applying them so that they shall come in contact with those insects, situated as they usually are; but in this respect smoke has every advantage; it penetrates and pervades their inmost recesses. The smoke of common vegetables, however powerful, is found to be inadequate to their destruction, and hitherto no other than that of tobacco is found to be effectual. That, judiciously applied, completely answers the purpose, without injuring the plant. It mostly happens, in well.

well-managed houses, that a few plants only are infested with aphides; in such a case the smoking of the whole house is a business of unnecessary expence and trouble; and we would recommend it to persons who have large collections to make use of a box of a commodious form that shall hold about a dozen plants of various sizes, to be used as a sort of hospital, in which the infested plants may be smoked separately, and the insects more effectually destroyed, because it may be rendered more perfectly smoke-tight.

“ To prevent the calamities which would infallibly result from the accumulated multiplication of the more prolific animals, it has been ordained by the Author of Nature that such should be diminished by serving as food for others. On this principle we find that most animals in this predicament have one or more natural enemies. The helpless aphid, the scourge of the vegetable kingdom, has to contend with many. The principal are the *Coccinella*, the *Ichneumon aphidum*, and the *Musca aphidivora*. Such as are unacquainted with the history of insects will learn with surprise that the *Coccinella*, a common insect, well known even to children by the name of the lady-bird, is one of the greatest destroyers of the aphides, which indeed are its only food, its sole support, as well in its perfect as in its larva or grub state. During the severity of winter this insect secures itself under the bark of trees or elsewhere. When the warmth of spring has expanded the foliage of plants, the female deposits its eggs on them in great numbers, from whence in a short time proceeds the larva, a small grub, of a dark lead-colour spotted with orange: these may be observed in the summer season running pretty briskly over all kinds of plants; and if narrowly watched, they will be found to devour the aphides wherever they find them. The same may be observed of the lady-bird in its perfect state. As these

these insects in both their states are very numerous, they contribute powerfully to diminish the number of aphides.

“ Another most formidable enemy to the aphis is a very minute black and slender ichneumon fly, which eats its way out of the aphis, leaving the dry inflated skin of the insect adhering to the leaf like a small pearl. Such may always be found where aphides are in plenty. We have observed different species of aphides to be infested with different ichneumons. In general the torpid aphis submits quietly to this fatal operation; but we have observed some of them, especially one that feeds on the sycamore, which is much more agile than many of this race, endeavouring to avoid the ichneumon with great address. There is perhaps no genus of insects which in their larva or maggot state feed on such a variety of food as the musca or fly. There is scarcely a part of Nature, either animate or inanimate, in which they are not to be met with. One division of them, called by Linnæus *muscæ aphidivoræ*, feeds entirely on aphides. Of the different species of aphidivorous flies, which are numerous, having mostly bodies variegated with transverse stripes, their females may be seen hovering over plants infested with aphides, among which they deposit their eggs on the surface of the leaf. The larva or maggot produced from such eggs feeds, as soon as hatched, on the younger kinds of aphis, and as it increases in size, attacks and devours those which are larger. These larvæ are usually of a pale colour, adhere closely to the leaf, along which they slowly glide, and are formed very tapering towards the head. When fully grown, they change to a pupa or chrysalis attached to the leaf, from whence issues the fly. The larvæ of these flies contribute their full share to diminish the despoilers of Flora. To these three kinds of insects, which are the chief agents in the hands of Nature for keeping the aphides within

their proper limits, we may add a few others, which act a subordinate part in this necessary business of destruction. The larva of the hemerobius feeds on them in the same manner as that of the *musca aphidivora*, and deposits its eggs also on the leaves of such plants as are beset with aphides. The eggs of this hemerobius stand on long filaments, which are attached by a base to the leaf, and have more the appearance of filaments of flowers with their antheræ than the eggs of an animal. The number of these insects being comparatively small, they may be considered rather as the casual invaders of their existence than the main host of their destroyers. The earwig, which is itself no contemptible enemy to plants, makes some atonement for its depredations by destroying the aphides, especially such as reside in the curled-up leaves of fruit-trees, and the purses formed by certain aphides on the poplars and other trees. Lastly, we may add as the enemies of these creatures, some of the smaller soft-billed birds, which generally feed on insects, and which may be frequently seen busily employed in picking them from the plants.

“ When plants assume a sickly appearance, or are disguised by disease, from whatever cause the disease may arise, they are said to be *blighted*. Blights originate from a variety of causes, the chief of which are unfortunate weather, and insects. Two opinions prevail very generally in regard to blights: the one that the insects which cause them are brought from a distance by easterly winds; the other that they attach themselves to none but plants already sickly. Neither of these opinions, as far as I have observed, is founded in fact. I am induced from the numerous observations I have made on insects for a series of years, (in pursuing the cultivation of plants,) to consider the aphids as by far the most general cause of the diseases distinguished by the name of blights. Other insects it is true, more especially the larvæ of some
of

of the lepidoptera, as those of the *Phalænæ* tortrices, disfigure and do infinite mischief to plants by rolling and curling up the leaves; but these for the most part confine themselves to certain trees and plants. Their ravages are also of shorter duration, being confined to the growth of one brood, and they are also less fatal. It would be no difficult matter for me to fill a volume with observations to which I have been an eye-witness of the injuries which plants sustain from insects; but that would be foreign to my present purpose, which is to shew that the aphis is the grand cause of these diseases, and to place the *modus operandi*, or manner in which they effect this business, in its true light.

“ We are fully aware that certain gregarious insects may at particular times rise up in the air, and if small and light, be impelled by any wind that may chance to blow at the time; and on this principle we account for that ‘ shower of aphides’ described by Mr. White to have fallen at Selborne. But certainly this is not the mode in which those insects are usually dispersed over a country. The phenomenon is too unusual, the distribution would be too partial; for the aphides, while at their highest point of multiplication, do not swarm like bees or ants, and fly off in large bodies; but each male or female aphis, at such periods as they arrive at maturity, marches or flies off, without waiting for any other. Yet it may happen, that from a tree or plant thickly beset with them numbers may fly off or emigrate together, being arrived at maturity at the same moment of time. Detaching itself from the plant, each pursues a different route, intent on the great business of multiplying its species; and settles on such plants in the vicinity as are calculated to afford nourishment to its young. The common green aphis, which is so generally destructive, lives during the winter season on such herbaceous plants as it remained on during the autumn,

either in its egg or perfect state. If the weather be mild, it multiplies greatly on such herbage; as the spring advances, in May the males and females of these insects acquire wings; and thus the business of increase, hitherto confined, is widely and rapidly extended, as the winged aphides, by hop-planters called *the fly*, may be seen at this period very generally sitting on plants, and floating in the air in all directions."

Mr. Curtis, in the preceding observations on the genus *aphis*, having mentioned the shower of aphides recorded by Mr. White, it cannot but be agreeable to the reader to be made acquainted with so curious a phenomenon in the words of its describer. "As we have remarked above, that insects are often conveyed from one country to another in a very unaccountable manner, I shall here mention an emigration of small aphides, which was observed in the village of Selborne no longer ago than August the 1st, 1785. At about three o'clock in the afternoon of that day, which was very hot, the people of this village were surprised by a shower of Aphides or smother-flies, which fell in these parts. Those that were walking in the streets at that juncture found themselves covered with these insects, which settled also on the hedges and gardens, blackening all the vegetables where they alighted. My annuals were discoloured with them, and the stalks of a bed of onions were quite coated over for six days after. These armies were then no doubt in a state of emigration, and shifting their quarters; and might have come, as far as we know, from the great hop-plantations of Kent or Suffex, the wind being all that day in the easterly quarter. They were observed at the same time in great clouds about Farnham, and all along the vale from Farnham to Alton."

The

The YARROW APHIS, *Aphis millefolii*.

This species is so named from its being principally found on that well-known plant the *Achillea millefolium*, or yarrow. It is a rather small species, and is of a green colour, spotted with black: the males are generally winged, and are smaller and more slender than the females.

The ROSE APHIS, *Aphis rosæ*.

Very frequent during the summer months on the young shoots and buds of roses: its size is nearly similar to that of the preceding, and its colour a bright green. The males are furnished with large transparent wings.

The LIME-TREE APHIS, *Aphis tiliæ*.

One of the most beautiful of the genus. It is of nearly the same size with the *rosæ*, but of a pale greenish yellow colour, with a row of black, crescent-shaped spots down each side of the abdomen, and a black stripe on each side the thorax. The wings are beautifully transparent, with brown nerves or veins, a black edging down the shoulder-part, and several dusky patches toward the tips.

The WILLOW APHIS, *Aphis salicis*.

This is one of the largest and most remarkable of the British species. It is found on the different kinds of willows, and is nearly a quarter of an inch in length, and of a yellowish-grey colour, spotted with black. When bruised, these insects stain the fingers of a red colour. Towards the end of September, according to the observations of Mr. Curtis, multitudes of the full-grown insects of this species, both winged and others, desert the willows on which they feed, and ramble over every neighbouring object in such numbers that we can handle nothing in their vicinity

vicinity without crushing some of them; while those in a younger or less advanced state still remain in large masses upon the trees.

CHERMES, THE CHERMES.

THE insects of the genus *Chermes*, like those of the genus *Aphis*, are found on the leaves, young shoots, and bark, of various vegetables. Their generic characters are drawn from the situation of the rostrum, which is placed in the breast; and from the shape of the antennæ, which are longer than the thorax. The wings are four in number, folding close along the sides of the abdomen; the feet are formed for leaping, their tarsi having two articulations. These animals are found inhabiting a great variety of different trees and plants, upon which they produce very singular excrescences: and the Linnæan names affixed to each species are, for the most part, derived from the particular tree upon which they feed. That of the fig-tree is the largest, and therefore more easily examined than any of the rest of the tribe. Other species, of inferior size, frequent the elm, the ash, the cherry, and the fir; that which inhabits the last of these trees is provided with a sharp-pointed instrument by which it makes punctures in the extremity of the branches, in order to deposit its young. By this means the fir-tree chermes produces that enormous scaly protuberance, which is often seen at the summit of the branches, and which is formed by the extravasation of the juices through the wounds thus made.

The larva chermes has six feet: in figure, it resembles the perfect insect; its shape is oblong; and its motion slow. In the chrysalid state, the form is somewhat changed, by two small protuberances upon the thorax, the rudiments of future wings. When the chrysalids are about to undergo their last metamorphoses, they retreat to the under side of a leaf,

to

OF HEMIPTEROUS INSECTS. 247

to which they remain attached without motion. On the approach of their change, the membrane above the head and thorax is seen to split and open: the perfect insect then comes forth with its wings, leaving the spoils of its chrysalis still adhering to the leaf, and rent on the anterior part. The empty sloughs of these insects are often found in great plenty beneath the leaves of the fig-tree. The tubercles raised upon the branches of trees by the punctures of the chermes, not only become the residence of the animal, but also of its eggs and larva, which are contained in those cells with which they abound. The box-tree chermes produces no excrescences upon that plant: its punctures make the leaves bend in towards each other at their extremity, where their union forms at the summit of the branch, a hollow knob, in which the larva of that insect find shelter. Both in their larva and chrysalid state, many of the chermes eject from the anus a white saccharine substance like the *honey-dew*, as it is called, of the aphis: within the hollow balls formed by the box-leaves, there are small soft grains of this substance deposited; and, in that state, it is frequently seen issuing from the anus of the insect that dwells there. The species are 24 in number, of which the following are the most remarkable.

The PEAR-TREE CHERMES, *Chermes pyri*.

Found on the leaves of the common pear-tree: its colour is a greenish-brown, varied with deeper streaks, and the wings are nearly transparent, spotted with brown. The larva of this species is of a greenish brown, with darker spots, and beset with short whitish hairs towards the hinder part of the body.

The BOX-TREE CHERMES, *Chermes buxi*.

A beautiful little insect, of a bright grass-green colour, with the wings of a similar cast. Its larva resides on the young shoots of box, in the early
part

part of spring, and secretes a considerable quantity of whitish viscid short filaments from the hind part, but not so as to envelop the body, which has generally more or less of a powdery appearance.

The ALDER-TREE CHERMES, *Chermes alni*.

Inhabits the branches of the *Betulus alni*. Its larva is entirely covered, about the hinder part, by thickly-fasciculated heaps of viscid down or cotton, which, if purposely rubbed off, are quickly re-produced by the animal, which secretes the white fibres from large pores placed in a circle at some distance from the vent. These larvæ are gregarious, often appearing in such numbers on the shoots of the tree that the whole shoot appears covered with white cotton, which, if touched by the finger, separates into distinct tufts from the animals' being suddenly disturbed and moving in all directions. When this cotton is brushed off, the larva appears of a pale green colour, varied with black spots, which on the upper part of the abdomen are disposed in two longitudinal rows: the tip of the abdomen is also black. When arrived at its complete or perfect state by casting its pupa skin, it is entirely green, with transparent wings veined with green and slightly shaded with brown. If disturbed, it leaps with much agility, frequently flying at the same time.

COCUS, THE COCHINEAL INSECT.

IN this genus, as in the preceding, the rostrum proceeds from the breast; the belly is bristly behind; the wings of the male are erect; and the female has no wings. There are 46 species, denominated principally from the plants they frequent. The most remarkable species are:

The GREEN-HOUSE BUG, *Coccus hesperidum*.

This species is oval, oblong, of a brown colour,
covered

OF HEMIPTEROUS INSECTS. 249

covered with a kind of varnish: it has six legs; with a notch and four bristles at the tail. It infests the orange-trees and other similar plants in green-houses. When young, it runs upon the trees; but afterwards fixes on some leaf, where it hatches an infinity of eggs, and dies. The male is a very small fly.

The WANDERING COCCUS, *Coccus adonidum*.

This is a very common species. The female, which, when nearly full grown, measures somewhat more than a fifth of an inch in length, has somewhat the appearance of a small millepede, or *oniscus*, being of an oval shape, slightly convex above, with the body divided into many transverse segments projecting sharply on the sides, and furnished with small processes or points; which are longer on the two hindmost divisions of the body than on the rest, so as to give the appearance of a bifid tail. The whole insect is of a pale rose-colour, and appears more or less covered with a fine white meal or powder. The legs are short, and six in number. This insect continues to wander about the plant it infests, nourishing itself by sucking the juices. The male is very small, rose-coloured, somewhat mealy, with semi-transparent milk-white wings, and four long filaments at the tail. When the female is full-grown, and pregnant with eggs, she ceases to feed, and, remaining fixed to one spot, envelopes herself in a fine white fibrous cotton-like substance, and lives but a very short time afterwards; the young, which hatch under the husk or body of the parent insect, proceeding from it in great numbers, and dispersing themselves in quest of food. This species is a native of the warmer parts of Africa and America, from whence it has long since been introduced, among exotics, into Europe.

The KERMES INSECT, *Coccus ilicis*.

Inhabits the *Quercus coccifera*, a species of oak
 VOL. XIII. No. 170. I i growing

growing in the southern parts of Europe. M. Heliot, of the French Academy of Sciences, says that this oak is found in the woods of Vauvert, Vendeman, and Narbonne; but more abundantly in Spain, towards Alicant and Valencia. It not only abounds in Valencia, but also in Murcia, Jaen, Cordova, Seville, Estremadura, la Mancha, and Serranias de Cuença; in all which places the kermes consequently abounds. In Xixona and Tierra de Rellou, in the district called *De la Grana*, the people of Valencia first began to gather it, whose example was followed all over Spain. It has some years produced 30,000 dollars (5000l.) to the inhabitants of Xixona alone.

Both ancients and moderns seem to have had very confused notions concerning the origin and nature of the kermes; some considering it as a fruit, without a just knowledge of the tree which produced it; others taking it for an excrescence formed by the puncture of a particular fly, the same as the common gall observed upon oaks: Tournefort was among this number. Count Marfigli, and Dr. Nisole, a physician of Montpellier, made experiments and observations, with a view of further discoveries, but did not perfectly succeed. Two other physicians at Aix, Dr. Emeric and Dr. Garidel, applied themselves about the same time, and with greater success; for they discovered that the kermes was the body of an insect, transformed according to the course of nature. The progress of this transformation is to be considered at three different seasons. In the first stage, at the beginning of March, an animalcule, no larger than a grain of millet, scarcely able to crawl, is perceived sticking to the branches of the tree, where it fixes itself, and soon becomes immoveable; at this period it grows the most, appearing to swell and thrive with the sustenance it draws in by degrees. This state of rest seems to have deceived the curious observer, as it then resembles an excrescence of the bark; during this period of its growth,

growth, it appears to be covered with a down, extending over its whole frame like a net, and adhering to the bark; its figure is convex, not unlike a small floe; in such parts as are not quite hidden by this soft net work, many bright specks are perceived of a gold colour, as well as stripes running across the body from one space to another. At the second stage, in April, its growth is completed; its shape is round, and about the size of a pea: it has then acquired more strength, and its down is changed into dust, and seems to be nothing but a husk or a capsule, full of a reddish juice, not unlike discoloured blood. Its third state is towards the end of May, a little sooner or later, according to the warmth of the season. The husk appears replete with small eggs, less than the seed of a poppy. These are ranged under the belly of the insect, progressively placed in the nest of down that covers its body, which it withdraws in proportion to the number of eggs; after this work is performed, it soon dies, though it still adheres to its position, rendering a further service to its progeny, by shielding them from the inclemency of the weather, or the hostile attacks of an enemy. In a good season they multiply exceedingly, having from 1800 to 2000 eggs, which produce the same number of animalcules. When observed with the microscope in July or August, we find, that what appeared as dust, are so many eggs or open capsules, as white as snow, out of each of which issues a gold-coloured animalcule, of the shape of a cockroach, with two horns, six feet, and a forked tail.

The custom of lopping off the boughs, to take them, is very injudicious, as by this means they destroy the next year's harvest. Strong dews will occasionally make them fall from the trees sooner than usual; but when the proper season passes, they fall off of themselves, and become food for birds, particularly doves. Sometimes there will be a second production, which

is commonly of a less size, with a fainter tinge. The first is generally found adhering to the bark, as well as on the branches and stalks; the second is principally on the leaves, as the worms choose that part where the nutritious juice preserves itself the longest, is most abundant, and can be most easily extracted in the short time that remains of their existence, the bark being then drier and harder than the leaves.

Those who procure the kermes to send to foreign parts, spread it on linen, taking care to sprinkle it with vinegar, to kill the worms that are within, which produces a red dust, which in Spain is separated from the rest. Then they let it dry, passing it through a sieve, and make it up into bags. In the middle of each package, its proportion of red dust, put in a little leather bag, also belongs to the buyer; and then it is ready for exportation, being always in demand on the African coast. The people of Hinojos, Bonares, Villalba, and other parts of Seville, dry it on mats in the sun, stirring it about, and separating the red dust, which is the finest part, and being mixed with vinegar, goes by the name of *pastel*. The same is done with the husks; but these have but half the value of the dust. The kermes of Spain is preferred on the coast of Barbary, on account of its goodness. The people of Tunis mix it with that of Tetuan, for dying those scarlet caps so much used in the Levant; indeed before the discovery of America, the *kermes*, as it was then termed, was the most valuable substance for dying scarlet, and was collected in great quantity for that purpose. Woollen cloth dyed with kermes was called scarlet *in grain*; the animal having been popularly considered as a grain. The colour is a durable deep red, called ox-blood colour, much inferior to the brilliancy of cochineel scarlet, but far more lasting, and less liable to stain. Mons. Hellot, in his *Art de Teindre*, observes that the figured cloths to be seen in the old tapestries of Brussels and the other manufactures

OF HEMIPTEROUS INSECTS. 253

manufactures of Flanders, which have scarcely lost any thing of their liveliness by standing for two hundred years, were all dyed with this ingredient.

The GUM-LAC INSECT, *Coccus ficus*.

A native of the East Indies. These insects traverse the branches of the trees upon which they were produced for some time, and then fix themselves upon the succulent extremities of the young branches. By the middle of January they are all fixed in their proper situations; they appear as plump as before, but show no other marks of life. The limbs, antennæ, &c. are no longer to be seen. Around their edges they are environed with a spissid subpellucid liquid, which seems to glue them to the branch; it is the gradual accumulation of this liquid which forms a complete cell for each insect, and produces what is called *gum lacca*, though it is not properly a gum.

Lacsha is the Indian name of this insect; and the most recent and genuine account of it is that in the second volume of the Asiatic Researches. It is by Mr. Roxburgh, surgeon on the Madras establishment, and was communicated to the Society by Dr. James Anderson, physician at Fort St. George.

“Some pieces of very fresh-looking lac, (says Mr. Roxburgh,) adhering to small branches of *Mimosa cinerea*, were brought me from the mountains on the 20th of November 1789. I kept them carefully; and to-day, the 4th of December, fourteen days from the time they came from the hills, myriads of exceedingly minute animals were observed creeping about the lac and branches it adhered to, and more still issuing from small holes over the surface of the cells: other small and perforated excrescences were observed with a glass amongst the perforations, from which the minute insects issued, regularly two to each hole, and crowned with some very fine white hairs. When the hairs were rubbed off, two white spots appeared. The animals,

imals, when single, ran about pretty briskly, but in general they were so numerous as to be crowded over one another. The body is oblong, tapering most towards the tail, below plain, above convex, with a double, or flat margin: laterally on the back part of the thorax are two small tubercles, which may be the eyes: the body behind the thorax is crossed with twelve rings: legs six; feelers (*antennæ*) half the length of the body, jointed, hairy, each ending in two hairs as long as the *antennæ*: rump, a white point between two terminal hairs, which are as long as the body of the animal. The mouth I could not see. On opening the cells, the substance that they were formed of cannot be better described, with respect to appearance, than by saying it is like the transparent amber that beads are made of. The external covering of the cells may be about half a line thick, is remarkably strong, and able to resist injuries: the partitions are much thinner: the cells are in general irregular squares; pentagons and hexagons, about an eighth of an inch in diameter, and one quarter deep: they have no communication with each other. All those I opened during the time the animals were issuing, contained, in one half a small bag filled with a thick red jelly-like liquor, replete with what I take to be eggs; these bags, or *utriculi*, adhere to the bottom of the cells, and have each two necks, which pass through perforations in the external coat of the cells, forming the fore-mentioned excrescences, and ending in some very fine hairs. The other half of the cells have a distinct opening, and contain a white substance, like some few filaments of cotton rolled together, and numbers of the insects themselves ready to make their exit. Several of the same insects I observed to have drawn up their legs, and to lie flat: they did not move on being touched, nor did they show any signs of life with the greatest irritation.

“December 5. The same minute hexapedes continue

tinue issuing from their cells in numbers: they are more lively, of a deepened red colour, and fewer of the motionless sort. To-day I saw the mouth: it is a flattened point about the middle of the breast, which the little animal projects on being compressed.

" December 6. The male insects I have found to-day: a few of them are constantly running among the females most actively: as yet they are scarce more, I imagine, than one to 5000 females, but twice their size. The head is obtuse; eyes black, very large; antennæ clavated, feathered, about two thirds the length of the body: below the middle an articulation, such as those in the legs: colour between the eyes a beautiful shining green: neck very short: body oval, brown: abdomen oblong, the length of body and head: legs six: wings membranaceous, four, longer than the body, fixed to the sides of the thorax, narrow at their insertions, growing broader for two thirds of their length, then rounded; the anterior pair is twice the size of the posterior; a strong fibre runs along their anterior margins: they lie flat, like the wings of a common fly when it walks or rests: no hairs from the rump: it springs most actively to a considerable distance on being touched: mouth in the under part of the head: maxillæ transverse. To-day the female insects continue issuing in great numbers, and move about as on the 4th.

" December 7. The small red insects still more numerous, and move about as before: winged insects, still very few, continue active. There have been fresh leaves and bits of the branches of both *Mimosa cinerea* and *Corinda* put into the wide-mouthed bottle with them; they walk over them indifferently, without showing any preference, or inclination to work or copulate. I opened a cell whence I thought the winged flies had come, and found several, eight or ten, more in it, struggling to shake off their incumbrances;

branches: they were in one of those utriculi mentioned on the 4th, which ends in two mouths, shut up with fine white hairs, but one of them was open for the exit of the flies; the other would no doubt have opened in due time: this utriculus I found now perfectly dry, and divided into cells by exceeding thin partitions. I imagine, before any of the flies made their escape, it might have contained about twenty. In these minute cells with the living flies, or whence they had made their escape, were small dry dark-coloured compressed grains, which may be the dried excrements of the flies."

These insects are transplanted by birds; if they perch upon these branches, they must carry off a number of the insects upon their feet to the next tree they rest upon. It is worth observing, that these fig-trees when wounded drop a milky juice, which instantly coagulates into a viscid ropy substance, which, hardened in the open air, is similar to the cell of the *Coccus lacca*. A red medicinal gum is also procured by incision from the plaso tree, so similar to the gum lacca, that it may readily be taken for the same substance. Hence it is probable, that those insects have little trouble in animalising the sap of these trees in the formation of their cells. The lacca brought into this country is principally found upon the uncultivated mountains on both sides the Ganges, where bountiful nature has produced it in such abundance, that, were the consumption ten times greater, the markets might be supplied by this minute insect. The only trouble in procuring the lac is in breaking down the branches, and carrying them to market. The best lac is of a deep red colour. If it is pale, and pierced at the top, the value diminishes, because the insects have left their cells, and consequently the dye or colour must be very weak and imperfect. This insect and its cell has gone under the various names of *gum lacca*,
lac,

OF HEMIPTEROUS INSECTS. 257

lat, and *loc-tree*; in Bengal, *la*; and by the English it is distinguished into three kinds, differently denominated.

The GRASS COCCUS, *Coccus phalarides*.

The male of this species is very small; but its antennæ are long for its size. The feet and body are of a reddish colour, nearly pink, and sprinkled with a little white powder. Its two wings, and the four bristles of its tail, are snow white, and of those filaments two are longer than the rest. It is to be found upon the species of grass which Linnæus calls *Phalaris Canariensis*. The female contrives to make, along the stalks of that grass, little nests, of a white cottony substance, in which she deposits her eggs. The small filaments of her tail are scarcely perceptible.

The POLISH COCCUS, *Coccus Polonicus*.

This species may properly enough be called the cochineal insect of the northern part of the world. As the true cochineal loves only the warm climates, so this affects only the cold ones. It is collected for the use of dyers; but the crops of it are much smaller, more difficultly made, and the drug itself greatly inferior to the true cochineal. It is vulgarly known by the name of the *scarlet grain of Poland*. That country is the place where it is gathered in the greatest abundance; but it is not the only one where it is found. It is to be met with in many of the northern countries; and possibly may be found in some of the more temperate ones, where it is not yet known; as it is very much obscured by nature from the eyes of common observers. It is found affixed to the root of a plant, and usually to plants of that species from thence called *polygonum cocciferum*; though authors have informed us of the same berry, as it is often called, being found at the roots of the mouse-ear, rupture-wort, pimpernel, and pellitory of

the wall: and that it is in no other than sandy places that it is found at the roots of those plants. Breynius, in 1731, printed at Dantzic a very curious account of this production, which first proved it incontestably to be an animal. Towards the end of June this coccus is in a fit state for being gathered. Every one of the insects is then nearly of a spherical form, and of a fine violet colour. Some of them, however, are not larger than poppy-seeds, and others of the size of a pepper-corn; and each of them is lodged, either in part or entirely, in a sort of cup like that of an acorn. More than half the surface of the body of the insect is covered by this cup. The outside of the covering is rough, and of a blackish brown; but the inside is smooth, polished, and shining. On some plants they find only one or two of these, and on others more than forty; and they are sometimes placed near the origin of the stalks of the plants. Breynius began his observations on the animals in this state, several of them being put into vessels of glass; and, by the 24th of July, there was produced from every one of them a hexapod, or six-legged worm, with two antennæ on its head. Several of these were kept a fortnight, and showed no inclination to eat any thing. They ran about, however, very swiftly for some time; but then began to be more quiet, drew up their bodies shorter, and ceased to run any longer. They were now of a purple colour; but in this state, though they did not walk about, they were subject to various contortions. At length, when they were become wholly motionless, their bodies became covered with a fine down; this was white, and formed them a perfect covering, which was sometimes of a spherical and sometimes of an irregular figure; it was always, however, very elegant; and the downy matter plainly enough transpired out of the animal's body. The insects remained in this state of rest, and covered with this down, for five or six days; but, at the
end

end of that time, every one of them had laid more than 150 eggs. These eggs were deposited upon the paper on which the animals were placed, and were enveloped in some measure by a downy matter. When the creatures had laid all their eggs, they died; and, about the 24th of August, there came from every egg a small insect, which, to the eye, scarcely seemed any other than a red point; it might, however, be observed very plainly to move about. These young animals lived a month wholly without sustenance. Breynius was induced at first to believe, that these insects came to be in a state to produce perfect eggs (like the aphides) without any congress with the male; but farther observation convinced him of the error of his opinion. He saw afterwards a sort of very small flies with two white wings bordered with red, produced from several of the cocci. These flies are of a similar kind with the male gall-insect. It has before been observed, that these cocci differ in size. The flies are produced by the small ones not bigger than a poppy seed; the others produce the worms before described; and one observation of Breynius's affords a plain proof that these flies are the male insects of the species; since all those of the females, which had been a day or two accompanied by those flies, quickly covered themselves with down and began to lay their eggs; whereas those which had not this commerce with the flies remained in the same state, or else got only a very thin and slight covering of down, and never laid any eggs.

The proper season for gathering this insect, as we have already observed, is about the end of June, when it is quite full of purple juice. Those who gather it have a hollow spade with a short handle; then, taking hold of the plant with one hand, they raise it out of the ground with the tool held in the other; after which they very quickly and dexterously detach the insects, and replace the plant in the ground, where it

again takes root. The coccus is then separated from the earth by means of a sieve; and, in order to prevent them from turning into worms, they sprinkle them with very cold water or vinegar. Lastly, they are killed by exposure to the sun, or keeping them for some time in a warm place; but this must be done with caution, as too hasty drying spoils the colour. Sometimes they separate the insects from the vesicles with their fingers, and form them into balls; but, by this operation, the price is increased. We are informed by Bernard de Bemith, from whom this account is taken, that the harvest of coccus was farmed out to the Jews by some Polish lords, who had possessions in the Ukraine; that it was used by them, as well as the Turks and Armenians, for dying not only wool and silk, but the tails and manes of their horses; that, by its means, the Turkish women dyed the tips of their fingers of a beautiful carnation; and that it was formerly used by the Dutch, mixed with an equal quantity of cochineal, the coccus being purchased at a very dear rate; that beautiful paints may be prepared from this insect and pounded chalk, &c. This, however, Macquer supposes to have been exaggerated, as he never could produce with it any other than lilac, flesh-colour, or crimson; and he found it more expensive than cochineal, as not yielding one-fifth part of the colour.

The COCHINEAL INSECT, *Coccus cacti*.

The female of this species (so called from inhabiting the cactus genus of plants) is the true cochineal, so valuable for its beautiful red colour in dyeing and painting. When ground and prepared, it is sold under the name of *carmine*.

This insect, like all others, is of two sexes, but exceedingly dissimilar in their appearance. The female, which alone is valuable for its colour, is ill-shaped; tardy, and stupid; and in its full-grown pregnant or torpid

torpid state, swells or grows to such a size in proportion to that of its first or creeping state, that the legs, antennæ, and proboscis, are so small with respect to the rest of the animal as hardly to be discovered except by a good eye, or by the assistance of a glass; so that on a general view it bears as great a resemblance to a seed or berry as to an animal. This was the cause of that difference in opinion which long subsisted between several authors; some maintaining that cochineal was a berry; while others contended that it was an insect. We must also here advert to another error; viz. that the cochineal was a species of *Coccinella*, or lady-bird. This seems to have taken its rise from specimens of the *Coccinella cacti* of Linnæus being sometimes accidentally intermixed with the cochineal in gathering and drying. The male is a small and rather slender dipterous fly, about the size of a flea, with jointed antennæ, and white wings large in proportion to the body, which is of a red colour, with two long filaments proceeding from the tail. It is an active and lively animal, and is dispersed in small numbers among the females, in the proportion, according to Mr. Ellis, in the Philosophical Transactions, of about one male to a hundred and fifty or two hundred females.

These useful insects are bred on a plant which grows spontaneously throughout the Spanish settlements in South America, called by the natives *nopal*, and by the Spaniards *tyona*; and of which plantations are made for the purpose of breeding these insects. It is the *Cactus cochenilliferi* of Linnæus; but the *C. opuntia* produces it also.—The juice of the plant on which these insects breed is their sole nourishment, and becomes converted into their substance; when, instead of being thin and waterish, and to all appearance of little or no use, it is rendered of a most beautiful crimson colour. The plant is in May or June in its most vigorous state, and at this most favourable season

season the eggs are deposited among the leaves. In the short space of two months, from an animalcule, the insect grows to the size above mentioned: but its infant state is exposed to a variety of dangers: the violent blasts of the north wind often sweep away the eggs from the foliage of the plant: and, what is equally fatal to their tender constitutions, showers, fogs, and frosts, in turn attack them, and destroy their leaves, leaving the careful cultivator this only resource, namely, that of making fires at certain distances, and filling the air with smoke, which frequently preserves them from the inclemency of the weather. The breeding is also greatly obstructed by birds of different kinds, which are very fond of these insects; and the same danger is to be apprehended from the worms, &c. which are found among the plantations.

The cochineal-insect may, in some circumstances, be compared to the silk-worm, particularly in the manner of depositing its eggs. The insects destined for this purpose are taken at a proper time for their growth, and put into a box well closed, and lined with a coarse cloth, that none of them be lost: and in this confinement they lay their eggs and die. The box is kept close shut till the time of placing the eggs on the plant, when, if any motion is perceived, it is a sufficient indication that the animalcule has life, though the egg is so minute as hardly to be perceived; and this is the seed placed on the foliage, and the quantity contained in the shell of a hen's egg is sufficient for covering a whole plant. It is remarkable that this insect does not, in any visible manner, injure the plant, but extracts its nourishment from the most succulent juice, which it sucks by means of its proboscis through the fine teguments of the leaves.

The countries where cochineal insects are mostly bred, are Mexico, Peru, and the Portuguese settlements in South America. The following description
of

of these insects, and method of cultivating them in the Portuguese settlement of Rio de Janeiro, is given by Sir George Staunton, in his "Embassy to China," and which we can the more confide in, because the observations were made on the spot, while Lord Macartney's Squadron were taking in refreshments at that port.

The cochineal insect of Rio is convex, with legs of a clear bright red in both male and female, and the antennæ are moniliform, or bead-like. The male is a delicate and beautiful insect; the colour of the whole body a bright red, nearly resembling the pigment usually called red lake. The breast is elliptical, and slightly attached to the head; the antennæ about half the length of the body, the legs are of a more brilliant red than that of the other parts, two fine white filaments, about three times the length of the insect, project from the extremity of its belly or abdomen. The wings are two, erect, of a faint straw-colour, and of a very delicate texture. The female has no wings, is elliptic in its form, and convex on both sides, but most so on the back, which is covered with a white downy substance resembling the finest cotton; the abdomen is marked with transverse rugæ or furrows; the mouth is situated in the breast, having a brown beak, inclining to a purple tint, that penetrates the plant on which the insect feeds; its six legs are of a clear bright red. It becomes pregnant about twenty days after it is born, and dies after bringing forth an innumerable offspring, of so minute a size as to be easily mistaken for the eggs only of those insects. For about the space of a day they remain without any appearance of life or motion; but soon afterwards show signs of animation, and begin to move with great agility over the surface of the leaf on which the mother had deposited them. At this time they appear, under a magnifier, like small specks of red unshapen matter, thinly covered over with a fine cottony

cottony down. In three or four days this downy envelopement becomes visible to the naked eye; the insect it covered increasing rapidly in size, till the largest is nearly equal to a grain of rice. With this increase of size they decrease in motion, and when arrived at their full growth, they adhere to the leaf in a torpid state. At this period they are taken from the plant for use; but, if suffered to remain, will deposit their young, as already mentioned. Amongst the clusters of these insects, enveloped in their cotton, there are several cells, of a cylindric form, standing perpendicularly on the surface of the leaf. These cells are the chrysalides, or cocoons, of the male; and out of which the wings, in their nascent state, make their first appearance, and are visible about three days before the perfect insect is produced. It enjoys its existence, in that state, only three or four days, during which it impregnates the females.

The plant, on which this insect feeds, is called at Rio, *orimbela*, and is the *Cactus cochenilliferi* of Linnæus. The leaves are thick and fleshy; the upper side more flat, or even concave, than the opposite; are somewhat of an oval form, growing without stalks, but rising one immediately from the other's edge, as well as from the stem, armed with round and tapering prickles, about an inch, or nearly so, in length, and having a reddish purple blossom growing out of the top, which is the rudiment of the fruit. These plants grow, sometimes, to the height of twenty feet; but they are generally prevented from rising above eight feet, which is a size more convenient to the cochineal breeder, and at which the leaves are thought to contain juices most nutritious to the insects. The young leaves are of a dark green, but incline towards a yellow colour as they advance in age. The internal substance of the leaf is of the same colour with its exterior surface. It is easy to discern when any insects are upon the plant; they
first

first appear like a white powder thinly spread upon its flat or hollow side, which is marked, soon afterwards, with small protuberances of the same white downy substance, already said to resemble the finest cotton.

Another insect is found at the same time upon the cactus, which is supposed to be a species of ichneumon, that feeds upon the cochineal insect; but it has only two wings. The larva or caterpillar of this fly insinuates itself into the cotton with which the coccus is enveloped, and is scarcely distinguishable from the latter, except that it is a little more elongated, with somewhat longer legs, and that the cotton does not stick to it, whereas from the coccus it is with difficulty separated. When this fly is prepared to change its skin, it creeps out of the cotton upon the naked part of the leaf, increases quickly in its bulk, and its colour changes from that of a bright red to a clear yellow, with rings of brownish spots about its body. In a few days it becomes torpid: but, soon afterwards, contracting its rings with violent agitation, it deposits a large globule of pure red colouring matter; after which it immediately hangs itself upon the prickles of the leaf, and becomes a chrysalis, out of which issues, shortly, the perfect fly. From the circumstance of the colouring matter being deposited by this insect, previous to its change into the pupa state, it might be inferred, that any other insect, feeding on the same plant, would be productive likewise of the same colouring matter. Yet the leaf itself constantly gave out, while under examination by Sir George Staunton, only a transparent gelatinous fluid, perfectly colourless. The fruit, indeed, or fig, of the cactus, when ripe, contains a scarlet juice, which colours some of the excretions of those who eat it.

The profit to the Portuguese at Rio de Janeiro, from the cochineal, is inconsiderable, owing to an error in the preparation. Twice or thrice a-week the slaves, appropriated to this employment, go among

the cactus plants, and pick off carefully with a bamboo twig, shaped somewhat into the form of a pen, every full-grown insect they can find, with many not yet arrived to their perfect state; the consequence of which is, that the plants are never half stocked with insects, many of the females being destroyed before they have deposited their young. The natives of Mexico pursue a method very different. As soon as the periodical rains are over, and the weather is warmer, as well as drier, they fix, on the prickles of the cactus leaves, small parcels of the finest moss, serving as nests to contain each ten or a dozen full-grown female insects. These, in the course of a few days, bring forth an innumerable tribe of young, spreading themselves over the leaves and branches of the plant, till they become attached to those spots which they find most favourable for supplying nutritious juice; where, soon acquiring their full growth, they remain motionless, and then are gathered off for use; a sufficient number being always left for the production of new broods. The insects are soon converted into cochineal by a very simple process; but if, "in corporal sufferance, the poor beetle feels a pang as great as when a giant dies," this process is not more simple than it is cruel. The insects, which are collected in a wooden bowl, are thickly spread, from thence, upon a flat dish of earthen ware, and placed alive over a charcoal fire, where they are slowly roasted until the downy covering disappears, and the aqueous juices of the animal are totally evaporated. During this operation the insects are constantly stirred about with a tin ladle, and sometimes water is sprinkled upon them, to prevent absolute torrefaction, which would destroy the colour, and reduce the insect to a coal; but a little habit teaches when to remove them from the fire. They then appear like so many dark round reddish grains, and take the name of cochineal: preserving so little the original

ginal form of the insect, that this precious dye was long known and sought in Europe before naturalists had determined whether it was an animal, vegetable, or mineral, substance. The garden at Rio does not, annually, produce above thirty pounds weight of this commodity; though by proper treatment, from the same number of plants, ten times the quantity might be obtained. At Marica and Saquarima, both contiguous to Cape Frio, are considerable plantations of the cactus, which are propagated easily from cuttings set into the earth during the cold and rainy season, though they afterwards thrive least where excluded from the sun. The insects breed and are collected, in dry weather, from October until March. The preparation of cochineal is encouraged by the trade being laid open, which had formerly been a monopoly to the crown of Portugal.

The MAILED COCCUS, *Coccus cataphractus*.

This very singular species was described several years ago in the fifth volume of the Naturalist's Miscellany, from a specimen communicated to Dr. Shaw by the ingenious Mr. Dickson, gardener to the British Museum. Mr. Dickson requested Dr. S. to examine its characters, and endeavour to ascertain its genus. He accordingly made a microscopic survey of the animal, and could not but conclude it to be a species of Coccus, and most probably the *C. conchiformis* of Linnæus, which lives upon the elm. We shall present Dr. Shaw's account to our readers.

“ The natural size of this insect (of which the female alone appears at present to be known) is that of the *Coccinella tigrina*, or small yellow-spotted lady-bird, and at first view has an appearance so little allied to the generality of the Cocci as to make it doubtful whether it really belongs to that tribe of insects. The whole animal (except the eyes, legs, antennæ, and rostrum) is coated, in the most curious

manner, in a complete suit of milk-white armour, as if cased in ivory. The divisions or annuli of the back are eight in number, of which the three superior ones are each furnished with a small scutellum or appendicular piece, which is wanting in the others. The sides are surrounded by projecting laminæ, somewhat in the manner of tortoises or millepedes: the lower surface is composed of angular pieces, disposed nearly as in the former of the above-mentioned animals: the eyes, which are situated just below or on the under side of the antennæ, are bright, and somewhat elevated, not unlike those of a lobster: the colour of the projecting parts, viz. the legs, eyes, antennæ, and rostrum, is a fine bright ferruginous or reddish brown. The eggs were small in proportion to the animal, and of a brown colour. It is from the singular manner in which this insect is coated that I have given it the title of *Coccus cataphractus*, or mailed coccus. It was found among sphagnum and other mosses in boggy and turfy ground; and is most frequent in Scotland, Ireland, and the north of England, particularly in some parts of Cumberland. If it really belongs to the genus *Coccus*, it is much to be wished that by a diligent search the male may at length be discovered, in order that the history of so curious an insect may be rendered complete."

The MINUTE COCCUS, *Coccus minutus*.

A very small species of this genus is often seen, in its fixed or torpid state, on the surface of different kinds of apples, and particularly on the golden pippin. It is not more than the tenth of an inch in length, and is of a long oval shape, gradually decreasing to a point at one end. It contains thirty or forty oval white eggs enveloped in a silky matter. This species seems to be very nearly allied to one described by the ingenious Mr. Baker, in his work entitled *Employment for the Microscope*, p. 371. Mr. Baker describes

OF HEMIPTEROUS INSECTS. 269

describes the twigs of an ash as thickly covered on one side with very numerous small spots of the size of very small pin's heads, and of nearly the same colour with the bark itself: each when opened was found to contain thirty or forty eggs. On placing this twig in the ground, in a favourable situation, where the sun shone freely on it, after a certain time prodigious swarms of extremely minute cocci proceeded from the eggs contained in their respective tubercles. They were of a beautiful scarlet colour, and measured about the hundred and fourteenth part of an inch in length. Their general appearance was very much that of an *Oniscus* or millepede, but with six legs, two short bristles at the tail, and antennæ of a strong appearance, resembling a pair of forceps, being each curved inwards and pointed. If the male of this animal, which even in its full-grown or fixed state, is not more than the twentieth of an inch in length, bears the usual proportional difference of size to the female with the rest of the genus, it must surely be one of the most minute of all winged insects.

THRIPS, THE THRIPS.

IN this genus the rostrum is so obscure, from its minuteness, as to be scarcely perceptible: the antennæ are filiform, and as long as the thorax; the body is of equal thickness through the whole length, and slender; the four wings are extended along the back, narrow in proportion to their length, and crossed at some distance from the base; the abdomen is bent upwards, and the feet commonly have two articulations. Only 8 species are enumerated; and these are so minute, that they are not objects of discussion unless viewed with a microscope: to the naked eye they appear rather like atoms than living animals. They reside commonly upon flowers, and under the bark of trees, and it is there also that their larvæ are found, which only differ from them by their wanting wings and elytra.

The

The GRAIN THRIPS, *Thrips physapus*.

This is a very small slender insect, of a black colour, very frequently seen during the spring and summer on various flowers, more especially on what are termed the compound flowers, as Dandelion, &c. It wanders about the petals of the flower, descending to the bottom of the florets, occasionally emerging at intervals, and often skipping from place to place, in performing which action it is observed suddenly to turn back its abdomen, so as nearly to touch the thorax with its tip. The wings are of a semi-transparent white, narrow, and, when properly magnified, are observed to be edged and tipped with hairs growing gradually longer as they approach the tips, where they are of considerable length: the lower wings are rather shorter than the upper, beneath which they are, in general, almost concealed: the antennæ consist of six joints, and the feet are tipped with an expanse and apparently vesicular process, enabling the little animal to adhere at pleasure with the greater security to any particular substance. All these particulars require a microscope for their investigation, the whole insect not exceeding the tenth of an inch in length. The larva in a great degree resembles the complete insect, but is destitute of wings: when very young it is white, and afterwards of a yellowish or reddish colour, and, like the complete insect, is seen wandering about the petals of flowers.

This insect has been supposed to do much injury to wheat, rye, &c. by causing the young flowers to decay; thus preventing the growth of the embryo grain. This opinion however has by some been considered as erroneous, who have contended that the thrips does not attach itself to such of the cerealia as are in a perfectly healthy state, but rather to such as are diseased. The ingenious Mr. Kirby however seems convinced that the thrips is in reality an insect
highly

OF LEPIDOPTEROUS INSECTS. 271

highly injurious to corn, by deriving its nourishment from the embryo grains. See much on this subject in the Transactions of the Linnæan Society, vols. iii. iv. v.

ORDER III. LEPIDOPTEROUS INSECTS.

THIS Order contains all the different kinds of the moth and butterfly; insects characterised by four wings, which are imbricated with scales, as the name imports; and by a mouth furnished with a spiral tongue, which can be extended or rolled up at pleasure. The bodies of all this class are covered with down, and their wings decorated with such a variety of brilliant colours, that they may be regarded as the most beautiful with which nature has enlivened and adorned the fields. This splendid order of insects also furnishes the most conspicuous example of the surprising difference in appearance between the larva or first state of the same animal and its complete or perfect state, in which it is capable of breeding. The Lepidopterous Insects are divided into three genera, viz. *Papilio*, *Sphinx*, and *Phalæna*; or Butterfly, Sphinx, and Moth.

PAPILIO, THE BUTTERFLY.

GENERIC characters, Antennæ thickening towards the extremity, commonly terminating in a knob or clavated tip. Wings (when sitting) erect and meeting upwards: (flight diurnal.)

There is no class of insects which hath been more accurately examined, or whose history hath been so fully detailed, as that of the butterfly and moth. Two large volumes have been dedicated solely to this tribe by the indefatigable Reaumur. The metamorphosis of insects is better illustrated by their history, because in them these changes are more frequent, and more perceptible.

The larvæ of butterflies are universally and emphatically known by the name of Caterpillars, and are

are extremely various in their forms and colours; some being smooth, others beset with either simple or ramified spines, &c. and some are observed to protrude from their front, when disturbed, a pair of short tentacula or feelers, somewhat analogous to those of a snail.

A caterpillar, when grown to its full size, retires to some convenient spot, and, securing itself properly by a small quantity of silken filaments, either suspends itself by the tail, hanging with its head downwards, or else in an upright position, with the body fastened round the middle by a proper number of filaments. It then casts off the caterpillar skin, and commences chrysalis, in which state it continues till the inclosed butterfly is ready for birth, which, liberating itself from the skin of the chrysalis, remains till its wings, which are at first very short, weak, and covered with moisture, are fully extended: this happens in the space of about a quarter of an hour, when the animal suddenly quits the state of inactivity to which it had been so long confined, and becomes at pleasure an inhabitant of air. It is then that the insect enters upon a more enlarged sphere of action, with increased powers: he ranges from flower to flower, darting his rostrum into their nectaria for the delicious stores they contain. Then too, in the full possession of every faculty granted to his race, he prepares to multiply and perpetuate it. This last and most considerable metamorphosis is attended with a greater change in the economy of the animal than any of the preceding; not only the skin, but the teeth, jaws, and cranium, are left behind. The large artery which passes along the body may be considered as a succession of different hearts employed in circulating the blood, which is at that important æra observed to flow in a different direction from what it did before, like the fœtus of a quadruped after birth. Formerly it circulated from the extremity to the head: it now pursues a course directly opposite.

Some

OF LEPIDOPTEROUS INSECTS. 273

Some of these animals are gregarious, and live in society during every stage of their existence; others live in that state during one period of their lives only. The duration of their life is various according to the weather; its warmth accelerates every step of their progress, and cold retards all their developments: a worm produced in a certain period of the summer lives only for three months, while the same species, if hatched a little later in the season, lives another year; hence Reaumur devised a method of prolonging the lives of these animals greatly beyond their natural course.

Butterflies of every species are extremely prolific; a single female at one birth produces several hundred eggs: and the most wonderful particular in the history of these insects, is the precautions by which they provide for the security of the young; some tear off the down from their own bodies to supply them with a covering.

Various insects prey upon the butterfly, or hasten the approach of its dissolution. A certain species of fly makes its way into its body, while yet a worm, and there deposits its eggs, and, although this worm continues to live, and be metamorphosed into a crysalis, no butterfly is produced from it; those internal parts that were essential to its preservation being consumed by the larvæ of the fly. From the great fecundity and variety of the insects of this genus, they probably would soon cover the surface of the earth, did not nature provide a bar to their increase, by multiplying their enemies: hence they are destined to become the food of a great number of animals of various kinds, some of which swallow them entirely, others macerate their bodies; while many accomplish their destruction by gradually sucking their juices. A single pair of sparrows, in order to supply themselves and their young, may destroy, as is supposed, three thousand three hundred and sixty butterflies in a week.

The vast number of animals belonging to this genus, and the variety and richness of their colouring, afford ample scope to the painter for the exercise of his art. It was chiefly of these insects that Madame Merian exhibited those exquisite drawings that constitute the peculiar merit of her work. It is principally in America, the East Indies, and China, that those species are found which constitute the ornament of our collections. From the policy of the latter country, the ladies are circumscribed in their amusements; there they domesticate various species of this tribe of insects, and make their economy and manners the principal study of their lives; large glass apartments, furnished with proper food, being fitted up for the accommodation of these animals.

The papilionaceous insects in general, soon after their enlargement from the crysalis, and commonly during their first flight, discharge some drops of a red-coloured fluid, more or less intense in different species. This circumstance, exclusive of its analogy to the same process of Nature in other animals, is peculiarly worthy of attention from the explanation which it affords of a phenomenon sometimes considered, both in ancient and modern times, in the light of a prodigy; viz. the descent of red drops from the air; which has been called a shower of blood: an event recorded by several writers, and particularly by Ovid, among the prodigies which took place after the death of the great dictator:

*Sæpe facies visæ mediis ardere sub astris,
Sæpe inter nimbos guttæ cecidere cruentæ.*

With threatening signs the lowering skies were fill'd,
And sanguine drops from murky clouds distill'd.

This highly-rational elucidation of a phenomenon at first view so inexplicable, seems to have been first
given

OF LEPIDOPTEROUS INSECTS. 275

given by the celebrated Peiresc, who with his own eyes observed the vestiges of an appearance of this kind in France in the year 1608, and was clearly convinced of its real origin, viz. the discharge above-mentioned from a species of butterfly, which happened during that season to be uncommonly plentiful in the particular district where the phenomenon was observed. The same idea was also entertained by Swammerdam, though he does not appear to have verified it from his own observation.

The prodigious number of species in this genus, 1157, makes it absolutely necessary to divide the whole into sections or sets, instituted from the habit or general appearance, and, in some degree, from the distribution of the colour on the wings. This division of the genus is conducted by Linnæus in a peculiarly elegant and instructive manner, being an attempt to combine, in some degree, natural and civil history, by attaching the memory of some illustrious ancient name to an insect of such or such a particular cast.

The first Linnæan division consists of the *Equites*, distinguished by the shape of their upper wings, which are longer, if measured from their hinder angle to their anterior extremity, than from the same point to the base. Some of this division have filiform or sharpened antennæ, in which particular they resemble Moths, but may generally be very clearly distinguished by their habit or general shape. The *Equites* are either *Troes*, Trojans, distinguished by having red or blood-coloured spots or patches on each side their breasts, or *Achivi*, Greeks, without red marks on the breast, of gayer colours in general than the former, and often having an eye-shaped spot at the inner corner of the lower wings.

The next division consists of the *Heliconii*. These are distinguished by the narrowness of their wings, which are also, in general, of a more transparent ap-
M m 2
pearance

pearance than in the other divisions; their upper wings are also generally much more oblong than the lower, which are short in proportion.

The third division consists of the *Danai*, (from the sons and daughters of Danaus.) They are divided into *Danai candidi*, or those in which the ground-colour of the wings is generally white; and the *Danai festivi*, in which the ground-colour is never white, and in which a greater variety of colour occurs than in the *Candidi*. The wings of the *Danai* are of a somewhat rounder shape than those of the *Heliconii*, or less stretched out.

The fourth section consists of the *Nymphales*, and is distinguished by the edges of the wings being scalloped or indented: it is subdivided into the *Nymphales gemmati*, in which eye-shaped spots are seen either on all the wings, or on the upper or lower pair only, and into the *Nymphales phalerati*, in which no ocellated spots are visible on the wings, but, in general, a great variety of colours.

The fifth section contains the *Plebeii*. These are, in general, smaller than the preceding kinds of butterflies, and are subdivided into *Plebeii urbicolæ*, or those in which the wings are marked by semi-transparent spots, and *Plebeii rurales*, in which the spots or patches have no transparency.

The arrangement made by Fabricius is upon the same principle, but something varied in the detail and subdivisions; and this last distribution is adopted by Dr. Turton in his translation of Gmelin's Linnæus.

The LARGE INDIAN BUTTERFLY, *Papilio Hector*.

Specific character, wings tailed, black; both surfaces the same colour; an interrupted white band across the upper pair, and numerous crimson spots on the lower. General colour deep velvet black. Native of the East Indies.

The

OF LEPIDOPTEROUS INSECTS. 277

The INDIAN BUTTERFLY, *Papilio Antenor*.

This is a very large species, measuring six inches and a half in extent of wings. Colour black, with numerous cream-coloured spots and patches; and the under-wings, which are tailed or furnished with a pair of lengthened processes in the middle, are edged with a row of red crescent-shaped spots. Native of India.

The AMBOYNA BUTTERFLY, *Papilio Priamus*.

Linnaeus considered this species as the most beautiful of the whole papilionaceous tribe: *Papilionum omnium princeps, longe augustissimus, totus holosericus, ut dubitem pulchrius quidquam, a Natura in insectis productum*. It measures more than six inches from wings-end to wings-end: the upper wings are velvet black, with a broad band of the most beautiful grass-green and of a satiny lustre drawn from the shoulder to the tip; and another on the lower part of the wing, following the shape of that part, and of a somewhat undulating appearance as it approaches the tip: the lower wings are of the same green colour, edged with velvet-black, and marked by four spots of that colour, while at the upper part of each, or at the part where the upper-wings lap over, is a squarish orange-coloured spot: the thorax is black with sprinklings of lucid green in the middle, and the abdomen is of a bright yellow or gold-colour. On the under side of the animal the distribution of colours is somewhat different, the green being disposed in central patches on the upper wings, and the lower being marked by more numerous black as well as orange spots. The Priamus is a very rare insect, and is a native of the island of Amboyna.

The ASIAN BUTTERFLY, *Papilio Sarpedon*.

A highly elegant species. The wings are of a lengthened shape, and the lower pair are stretched downwards

downwards into a pointed process. The whole animal is black, with a broad interrupted pea-green stripe or band passing through all the wings: on the lower part is also a border of crescent-shaped green spots. Inhabits Asia.

The SWALLOW-TAILED BUTTERFLY, *Papilio Machaon*.

This is a species of great beauty, and may be considered as the only British species of *Papilio* belonging to the tribe of *Equites*. It is commonly known among the English collectors by the title of the swallow-tailed butterfly, and is of a beautiful yellow, with black spots or patches along the upper edge of the superior wings. All the wings are bordered with a deep edging of black, decorated by a double row of crescent-shaped spots, of which the upper row is blue, and the lower yellow: the under wings are tailed, and are marked at the inner angle or tip with a round red spot bordered with blue and black. The caterpillar of this species feeds principally on fennel and other umbelliferous plants, and is sometimes found on rue. It is of a green colour, encircled with numerous black bands spotted with red, and is furnished on the top of the head with a pair of short tentacula of a red colour, which it occasionally protrudes from that part. In the month of July it changes into a yellowish-grey angular chrysalis, affixed to some convenient part of the plant, or other neighbouring substance, and from this chrysalis in the month of August proceeds the complete insect. It sometimes happens that two broods of this butterfly are produced in the same summer, viz. the first in May, having lain all the winter in the chrysalis state; and the second in August, from the chrysalides of July.

The SIBERIAN BUTTERFLY, *Papilio Apollo*.

This is a native of many parts of Europe, but has
not

OF LEPIDOPTEROUS INSECTS. 279

not yet been observed in our own country, and is somewhat larger than the common great cabbage-butterfly; of a white colour, with a slight semi-transparency towards the tips of the wings, which are decorated with velvet-black spots, and on each of the lower wings are two most beautiful ocellated spots consisting of a carmine-coloured circle with a white centre and black exterior border. The caterpillar is black, with small red spots, and a pair of short retractile tentacula in front: it feeds on orpine and some other succulent plants, and changes into a brown chrysalis, covered with a kind of glaucous or violet-coloured powder.

The COMMON LARGE WHITE BUTTERFLY, *Papilio brassicæ*.

This insect is too well known to require particular description, and it may be only necessary to remind the reader that it proceeds from a yellowish caterpillar freckled with bluish and black spots, and which changes during the autumn into a yellowish grey chrysalis, affixed in a perpendicular direction to some wall, tree, or other object, some filaments being drawn across the thorax in order the more conveniently to secure its position. The fly appears in May and June, and is seen through all the summer.

The AMERICAN BUTTERFLY, *Papilio Menelaus*.

This may be considered as one of the most splendidly beautiful of the butterfly tribe. Its size is large, measuring, when expanded, about six inches; and its colour is the most brilliant silver-blue that imagination can conceive, changing, according to the variation of the light, into a deeper blue, and in some lights to a greenish cast: on the under side it is entirely brown, with numerous deeper and lighter undulations, and three large ocellated spots on each wing. It is a native of South America, and proceeds, according to
Madam

Madam Merian, who has figured it in her work on the Surinam Insects, from a large yellow caterpillar, beset with numerous, upright, sharp, black spines. It changes into an angular chrysalis, of a brown colour, and distinguished by having the proboscis projecting in a semicircular manner over the breast: from this chrysalis, in about fourteen days, proceeds the complete insect.

The PEACOCK BUTTERFLY, *Papilio Io*.

A species by no means uncommon in this country. The ground colour is orange-brown, with black bars separated by yellow intermediate spaces on the upper edge of the superior wings, while at the tip of each is a most beautiful large eye-shaped spot, formed by a combination of black, brown, and blue, with the addition of whitish specks: on each of the lower wings is a still larger eye-shaped spot, consisting of a black central patch, varied with blue, and surrounded by a zone of pale brown, which is itself deeply bordered with black; all the wings are scoloped or denticulated. The caterpillar is black, with numerous white spots, and black ramified spines: it feeds principally on the nettle, changing into chrysalis in July, and the fly appearing in August.

The ADMIRABLE BUTTERFLY, *Papilio Atalanta*.

This common English species is of the most intense velvet-black colour, with a rich carmine-coloured bar across the upper wings, which are spotted towards the tips with white; while the lower wings are black, with a deep border of carmine-colour marked by a row of small black spots: the under surface of the wings also presents a most beautiful mixture of colours. The caterpillar is brown and spiny, feeds on nettles, and changes into a chrysalis in July, the fly appearing in August.

The

The IMPERIAL BUTTERFLY, *Papilio Paphia*.

A highly-elegant insect, of a fine orange-chestnut colour above, with numerous black spots and bars: beneath greenish, with narrow silvery undulations on the lower wings and black spots on the upper. It proceeds from a yellowish brown spiny caterpillar, living principally on nettles. This insect is generally found in the neighbourhood of woods.

The BLUE BUTTERFLY, *Papilio Marfyas*.

A very beautiful exotic species, a native of India, and of a most exquisite lucid blue colour, edged with black, and farther ornamented by having each of the lower wings tipped with two narrow black tail-shaped processes.

The BUTTERFLY, with SPIRAL PROBOSCIS, *Papilio vanillæ*.

Specific character, wings indented, yellow spotted with black; thirty silvery spots beneath. Inhabits America, chiefly on the plant called Epidendrum vanilla, whence the name.—This butterfly is shown in its perfect state on the large ENTOMOLOGY Plate I. fig. 6. p. 80. two of its fecundated eggs are shown magnified at fig. 9. and at fig. 11, Plate II. is represented the caterpillar of the same. For farther particulars relating to caterpillars and butterflies in general, their transformations, &c. see the introductory part of this vol. p. 38-44, and 54-61.

SPHINX, THE HAWK-MOTH.

GENERIC characters, Antennæ somewhat prismatic, tapering at each end; tongue (mostly) exerted; feelers two, reflected; wings deflected.

The name Sphinx is applied to the genus on account of the posture assumed by the larvæ of several of the larger species, which are often seen in an atti-

tude much resembling that of the Egyptian Sphinx, viz. with the fore-parts elevated, and the rest of the body applied flat to the surface. The number of species in this genus is 175. They fly abroad, especially the larger species, chiefly in the morning and evening, and some of them make a kind of humming noise. Like butterflies, they extract the nectary of flowers with the tongue. The larva has sixteen feet, and is pretty active; the pupa is quiescent, and differs in shape in the different species.

This tribe contains all those insects which hold an intermediate station between the butterflies and moths. Their wings fold down over the back when at rest; when on the wing their motions are slow and heavy. The insects belonging to this genus, though far less numerous in their varieties, present not uniformly the same characters to the observer: some have angulated wings; in others, the wings are entire; some are known by a barb, or tuft of hair, growing from the anus; while many are distinguished by other differences in their external appearance, both in the larva and winged state. These last, Linnæus has termed *adscitæ*, as if brought into the family by a sort of adoption, and thus distinguished from the legitimate sphinxes.

The cocoon which they form, previous to their metamorphosis, and into which the animal enters, is constructed below-ground, of earth and grains of corn interwoven with threads of their own manufacture. When invested with the powers of a winged insect, their voracity is diminished; they fly heavily from flower to flower, introducing the tongue into the nectaria for the-liquor contained there.

The EYED SPHINX, *Sphinx ocellata*.

Specific character, antennæ scaly, feelers hairy, tongue spiral; wings angular; the lower ones rufous, with an ocellate spot. A beautiful insect, four inches wide

OF LEPIDOPTEROUS INSECTS 283

wide from wing's end to wing's end. The upper wings and body are brown; the former finely clouded with different shades, while the lower wings are of a bright rose-colour, each marked with a large ocellated black spot with a blue interior circle and a black centre. This insect proceeds from a green caterpillar of a rough or shagreen-like surface, marked on each side by seven oblique yellowish-white streaks, and furnished with a horn at the tail. It is principally found on the willow; retires under ground, in order to undergo its change into the chrysalis state, in the month of August or September, and in the following June appears the complete insect.

The DEATH'S-HEAD SPHINX, *Sphinx atropos*.

The largest and most remarkable, if not the most beautiful, European insect of this genus. It very considerably exceeds in size the species just mentioned. The upper wings are of a fine dark grey colour, with a few slight variegations of dull orange and white; the under wings are of a bright orange colour, marked by a pair of transverse black bands: the body is also orange-coloured, with the sides marked by black bars, while along the top of the back, from the thorax to the tail, runs a broad blue-grey stripe. On the top of the thorax is a very large patch of a most singular appearance, exactly representing the usual figure of a skull or death's head, and is of a pale grey, varied with dull ochre-colour and black. When in the least disturbed or irritated, this insect emits a stridulous sound, something like the squeaking of a bat or mouse, and from this circumstance, as well as from the mark above-mentioned on the thorax, is held in much dread by the vulgar in several parts of Europe, its appearance being regarded as a kind of ill omen, or harbinger of approaching fate. We are informed by the celebrated Reaumur, that the members of a female convent in France were thrown into great consterna-

tion at the appearance of one of these insects, which happened to fly in during the evening at one of the windows of the dormitory. In the province of Brittany the people were afflicted during a certain season with an epidemic disorder, which often proved mortal; the inhabitants were greatly alarmed by the unusual numbers of these insects, which the common people imagined came to forbode their destruction, by this portentous representation upon their backs. The Royal Academy was consulted, whether the sphinx, by its uncommon numbers, might not be the cause of this calamity, so great was the alarm which their appearance created.

The caterpillar from which this curious sphinx proceeds is in the highest degree beautiful, and far surpasses in size every other European insect of the kind, measuring sometimes near five inches in length, and being of a very considerable thickness: its colour is a bright yellow, the sides marked by a row of seven most elegant broad stripes or bands, of a mixed violet and sky-blue colour: the tops of these bands meet on the back in so many angles, and are varied on that part with jet-black specks. On the last joint of the body is a horn or process, not in an erect position, as in the preceding kind, but hanging or curving over the joint in the manner of a tail, having a rough or mucronated surface and a yellow colour. This caterpillar is principally found on the potatoe and the jessamine, those plants being its favourite food. It usually changes into a chrysalis in the month of September, retiring for that purpose pretty deep under the surface of the earth; the complete insect emerging in the following June or July; but some individuals are observed to change into chrysalis in July or August; and these produce the complete insect in November; so that there appear to be two broods or annual races. The Sphinx atropos is generally considered as a very rare insect, and as the caterpillar feeds chiefly by night, concealing

OF LEPIDOPTEROUS INSECTS. 285

concealing itself during the day under leaves, &c. it is not often detected: yet, from some singular circumstances favourable to its breed, there are some seasons in which it is even plentiful, as in the autumn of the year 1804, in which the caterpillar was so common in some counties as to be very prejudicial to the potatoe-plants, particularly in some parts of Cornwall, Surry, &c.

The PRIVET HAWK-MOTH, *Sphinx ligustri*.

A large insect, measuring nearly four inches and a half from wing's end to wing's end. The upper wings are of a brown colour, most elegantly varied or shaded with deeper and lighter streaks and patches; the under wings and body are of a fine rose-colour, barred with transverse black stripes. The caterpillar, which is very large, is smooth, and of a fine green, with seven oblique purple and white stripes along each side: at the extremity of the body, or top of the last joint, is a horn or process pointing backwards. This beautiful caterpillar is often found in the months of July and August feeding on the privet, the lilac, the poplar, and some other trees, and generally changes to a chrysalis in August or September, retiring for that purpose to a considerable depth beneath the surface of the ground, and, after casting its skin, continuing during the whole winter in a dormant state, the sphinx emerging from it in the succeeding June.

The WASP-LIKE SPHINX, *Sphinx apiformis*.

Of an aspect at first sight more resembling a wasp or hornet than a sphinx, the wings being transparent with merely a slight edging of brown, and the thorax and abdomen varied with black and yellow. The caterpillar inhabits the hollows of poplar, fallow, willow, and lime, trees, feeding on the substance of the bark; changing to a chrysalis in April, and the fly appearing in the month of June.

The

The DROPWORT SPHINX, *Sphinx filipendulæ*.

Tongue exerted, setaceous. This is of a smaller size and of a somewhat different habit from the kinds above described, belonging to the division called *adscitæ* by Linnæus, but by Fabricius *zygænæ*. It is common in meadows towards the decline of summer; and is distinguished by having the upper wings of an oblong-oval shape, and of a dark shining green colour, with blood-red spots; and the lower wings red with a dark-green edging. The caterpillar is of a pale yellow, with rows of squarish black spots, and is often seen feeding on various meadow-plants and grasses: it does not undergo its change under ground, but encloses itself in an oval shining yellow web of silk, attached to the stem of some grass, &c. In this it changes into a chrysalis, out of which in about the space of three weeks emerges the complete insect.

PHALENA, THE MOTH.

THE moths are the most numerous genus hitherto known, either in the animal or vegetable world. Turton's Linnæus enumerates 1464 species, and probably is far short of the real number. They are more frequent in warm and dry climates than in ours; and they are more plentiful in South than North Britain. The characters by which this numerous genus is distinguished are the following: "The antennæ setaceous, diminishing in thickness from the base to the extremity; their wings, when at rest, are in general folded down; and they fly during the night." This genus, like that of *Papilio*, containing a vast number of species, is divided into assortments, according to the different habits of the animals. But these subdivisions are by no means accurate, nor shall we regard them, as we mean to describe only a few of the most remarkable species. It may be observed in general, that the greater part of the moths, when at liberty in the

OF LEPIDOPTEROUS INSECTS. 287

the fields, fly only during the night, or towards evening. Those which are domesticated in boxes made for that purpose, give indications, by their fluttering within, when the natural period of their activity approaches. During the day they remain quiet, and apparently reconciled to their confinement; but at night they flutter throughout the whole extent of their prisons, and testify their impatience at their want of freedom.

All the diurnal butterflies are provided with a rostrum for gathering, and for the reception of, their food; but a great part of the moths are entirely destitute of that organ, while in others it is so small as scarcely to be discernible with the naked eye. This singular fact hath been fully investigated by the indefatigable Reaumur, who, after examining many moths with a strong magnifier, was not able to discover the smallest vestige of a mouth. A considerable number, therefore, of these animals, must pass the whole of their winged state without food: these, of course, cannot be destructive to cloth or furs, except while they remain in the form of worms.

The caterpillars from which the various species of moths are produced, exhibit nearly the same variety of appearance as the winged insects which spring from them. Some are large, while others are extremely minute: many are provided with ten, others twelve and fourteen, feet; the largest and most common have sixteen. Some of the smaller caterpillars are smooth, and others covered with hairs, which produce an itchiness and an inflammation when they touch the human skin.

Moths, in their chrysalis state, differ from the butterflies, in remaining for a much longer period before their metamorphoses into perfect insects is completed. Their form, too, is then different, being oblong, and not angular, like the chrysalis of the butterfly. Some remain in their coques for several years successively;

successively; especially if a cold damp situation has retarded their progress. So great is the effect of heat in precipitating their developements, that a moth in a warm exposure may be produced from its chrysalis, even in the depth of winter.

After the phalænæ issue from their last covering, some of them are destitute of wings: these are the females of certain kinds, who, instead of wings, have only short protuberances, altogether unfit for the purpose of flying. They have the appearance of large creeping animals of a different order, and can only be recognised for moths by the shape of their antennæ, which are similar to those of the males, and by those scales with which the body of these animals is covered.

The Phalænæ, though less brilliant in colour than the butterflies, are some of them far superior in size. The Atlas and pavonia major of Linnæus are much larger than any species of the butterfly yet known: in bulk, they seem rather to resemble a bird than an insect; and in richness of clothing few of the feathered race can vie with them.

Though moths in general do not fly by day, yet in the summer evenings it is the light which attracts them into the dwellings of man. Then they are seen entering the rooms, and fluttering around the candles, where they often meet with a painful death. This fondness for light has suggested to the curious a method of catching these animals, by carrying a lantern into a bower, around which they all flock, and numbers are led into captivity.

Many of the species construct the abode in which they reside of the grains of wool which they gnaw off the cloth: their food is of the same substance; and what greatly increases the extent of their devastations is, that every step they advance upon cloth, feeling themselves incommoded by the wool in their way, they gnaw a smooth passage for themselves, like a man with

OF LEPIDOPTEROUS INSECTS. 289

with a scythe in his hand, cutting down the grafs of the meadow as he goes along. These habits of the moth render them among the most destructive of insects. The most costly articles of fur are those which are not worn every day; and for that very reason they are most exposed to their attacks. The methods for preventing their devastations may be reduced to the two following; either we must destroy the insects, or render our clothes disagreeable food for them. The moths may be destroyed by oil, or the fumes of tobacco. And, as wool is never subject to their depredations so long as it remains upon the sheep, the most likely method of rendering it disagreeable, is by restoring that greasy substance which is taken from it by washing, and other processes which it undergoes when manufactured.

The ATLAS MOTH, *Phalæna Atlas*.

Specific character, antennæ filiform; feelers two, compressed, reflected; tongue short and membranous; wings expanded, falcate, varied with yellow, white, and ferruginous, with a transparent spot on each. This is the most splendid, and the largest, of all the moths yet known: the extent of its wings measures not less than eight inches and a half. The ground-colour is a very fine deep orange-brown, and in the middle of each wing is a large subtriangular transparent spot or patch, resembling the appearance of a piece of Muscovy talc: each of these transparent parts is succeeded by a black border, and across all the wings run lighter and darker bars, exhibiting a very fine assortment of varying shades. The upper wings are slightly curved downwards at their tips in a falcated manner, and the lower wings are edged with a border of black spots on a pale buff-coloured ground: the antennæ are widely pectinated with a quadruple series of fibres, exhibiting a highly-elegant appearance. This insect is a native of both the Indies, and occasionally varies both in size and colours.

The MOON MOTH, *Phalæna luna*.

An American species, of large size, and extremely beautiful: its colour is a most elegant pea-green, with a small yellowish eye-shaped spot with a transparent centre in the middle of each wing; and the lower wings are produced at the bottom into a long and broad tail or continuation: the ridge of the upper wings is broad and of a fine purple-brown colour: the head and thorax yellowish white, and the body milk-white.

The PEACOCK MOTH, *Phalæna pavonia*.

A native of many parts of Germany, Italy, France, &c. but not yet observed in England. It measures about six inches in extent of wings, and is varied by a most beautiful assortment of the most sober colours, consisting of different shades of deep and light grey, black, brown, &c. on the middle of each wing is an eye-shaped spot, having the disk black, shaded on one side with blue; surrounded with red-brown, and the whole included by a circle of black: lastly, all the wings are bordered by a deep edging of very pale brown, with a whiter line immediately adjoining to the darker part of the wing: the antennæ are finely pectinated. The caterpillar, which feeds on the apple, pear, &c. is hardly less beautiful than the insect itself: it is of a fine apple or yellowish-green colour with each segment of the body ornamented by a row of upright prominences of a bright-blue colour, with black radiated edges, and surrounded by long black filaments, each of which terminates in a clavated tip. This larva, when ready for its change, envelops itself in an oval web with a pointed extremity, and transforms itself into a large short chrysalis, out of which afterwards emerges the moth. Dr. Shaw calls it *Junonia*.

α. The *Phalæna pavonia minor*, or Smaller Peacock Moth, is a native of England, and is commonly called the

OF LEPIDOPTEROUS INSECTS. 291

the Emperor Moth. In every respect except size it so greatly resembles the former, that Linnæus chose to consider it as a permanent variety only of the same species. The larva and pupa are also of the same appearance with those of the preceding, but on a much smaller scale.

The PUSS MOTH, *Phalæna vinula*.

This species is remarkable for elegance of appearance without gaiety of colour, being a middle-sized white moth, variegated with numerous small black streaks and specks: the thorax and abdomen are extremely downy, and the body is marked by transverse black bars.

The caterpillar of this moth is far more brilliant in its appearance than the complete animal. It is of considerable size, measuring above two inches in length, and is of a most beautiful green colour, with the back of a dull purple, freckled with very numerous deeper streaks in a longitudinal direction: this purple part of the back is separated from the green on the sides by a pair of milk-white stripes, which, commencing from the head, run upwards to the top of the back; that part being elevated considerably above the rest into a pointed process; and from thence are continued along the sides to the tail: the face is flat, and subtriangular, yellowish, surrounded first by a black, and then by a red, border; and is distinguished by two deep-black eyes or spots on each side the upper part: from the tail, which is extended into two long, roughened, sharp-pointed, tubular, processes, proceed, on the least irritation, two long, red, flexible, tentacula, the animal seeming to exert them as if for the purpose of terrifying its disturbers; lifting up the fore-part of the body at the same time, in a menacing attitude, and presenting a highly grotesque appearance: it also possesses the power of suddenly ejecting from its mouth, to a considerable distance, an acrimonious

reddish fluid, which it uses as a farther defence, and which produces considerable irritation if it happens to be thrown into the eyes of the spectator. This caterpillar is principally seen on willows and poplars, and, when the time of its change arrives, descends to the lower part of the tree, and envelops itself in a glutinous case, prepared by moistening with its saliva the woody fibres of the tree, and covering itself with them, attaching the edges very closely to the bark: this case, having very much the colour of the bark itself, is not very conspicuous, so that the insect generally remains secure under its covering throughout the whole winter, it being too close to be penetrated by the frost, and too strong to be successfully attacked by birds, &c. it requires even a very sharp knife, assisted by a strong hand, to force it open. The chrysalis is thick, short, and black, and in the month of May or June, according to the warmth or coolness of the season, gives birth to the moth, which, immediately on emerging from the upper part of the chrysalis, discharges a quantity of fluid sufficient to soften effectually the walls of its prison, and effect a ready escape. This moth, from its unusually downy appearance, has obtained the popular title of the *Puff Moth*.

The SILK-WORM MOTH, *Phalæna mori*.

Of all the moths this is by far the most important. It is a whitish moth, with a broad pale-brown bar across each of the upper wings.

The caterpillar or larva, emphatically known by the title of the *silk-worm*, is, when full grown, nearly three inches long, and of a yellowish grey colour: on the upper part of the last joint of the body is a horn-like process, as in many of the sphinges. It feeds, as every one knows, on the leaves of the white mulberry, in defect of which may be substituted the black mulberry, and even, in some instances, the lettuce,
and

and a few other plants. The silkworm remains in its larva state about six weeks, changing its skin four times during that period, and, like other caterpillars, abstaining from food for some time before each change. When full grown, the animal entirely ceases to feed, and begins to form itself a loose envelopement of silken fibres in some convenient spot which it has chosen for that purpose, and afterwards proceeds to enwrap itself in a much closer covering, forming an oval yellow silken case or ball about the size of a pigeon's egg, in which it changes to a chrysalis, and, after lying thus inclosed for the space of about fifteen days, gives birth to the moth. This however is always carefully prevented when the animals are reared for the purpose of commerce, the moth greatly injuring the silk of the ball by discharging a quantity of coloured fluid before it leaves the cell: the silk balls are therefore exposed to such a degree of heat as to kill the inclosed chrysalides; a few only being saved for the breed of the following year. The moth, when hatched, is a very short-lived animal; breeding soon after its exclusion, and, when the females have laid their eggs, they, as well as the males, survive but very short time.

The length of the silken fibre or thread drawn by the silkworm in forming his ball, is computed by Mons. Isnard, a French author, who wrote on the subject of the silk-worm in the seventeenth century, to be six English miles in length. This computation however appears to be a greatly exaggerated one. The length indeed may be supposed to differ considerably in different silk balls, but in general will be found far short of what is stated by Isnard. According to Boyle, as quoted by Derham, a lady, on making the experiment, found the length of a ball to be considerably more than three hundred yards, though the weight was only two grains and a half. The Abbé la Pluche informs us, that of two balls one measured nine hundred and
twenty-

twenty four feet, and the other nine hundred and thirty. It may be proper to add, that the silk throughout its whole length is double, or composed of two conjoined or agglutinated filaments.

The art of manufacturing silk is said to have been first invented in the island of Cos, by a woman of the name of *Pamphilis*, the daughter of *Platis*. The discovery was not long unknown to the Romans. Silk was brought to them from *Serica*, where the insect itself was a native; but so far were they from profiting by the discovery, that they could not be induced to believe so fine a thread to be the work of an insect, and formed many chimerical conjectures of their own on the subject. Silk was a very scarce article among them for many ages: it was even sold weight for weight with gold; insomuch that *Vopiscus* informs us that the emperor *Aurelian*, who died A. D. 275, refused the empress his wife a robe of silk, which she earnestly solicited, merely on account of its dearness. Others however, with greater probability, assert that it was known at Rome so early as the reign of *Tiberius*, about A. D. 17. *Galen*, who lived about the year of our Lord 173, speaks of the rarity of silk, being no where then but at Rome, and there only among the rich. *Heliogabalus* the emperor, who died A. D. 220, is said by some to have been the first person that wore a *holosericum*, i. e. a garment entirely of silk. The Greeks of the army of *Alexander the Great* are said to have been the first who brought wrought silk from *Persia* into *Greece*, about 323 years before Christ; but the manufacture of it was first confined to *Berytus* and *Tyre* in *Phœnicia*, whence it was dispersed over the West. At length, two monks, coming from the Indies to *Constantinople*, in 555, under the encouragement of the Emperor *Justinian*, brought with them great quantities of silk-worms, with instructions for hatching the eggs, rearing and feeding the worms, and drawing, spinning, and working, the silk.

Upon

OF LEPIDOPTEROUS INSECTS. 295

Upon this, manufactures were set up at Athens, Thebes, and Corinth. The Venetians, soon after this time commencing a commerce with the Greek empire, supplied all the western parts of Europe with silks for many centuries; though several kinds of modern silk manufactures were unknown in those times, such as damasks, velvets, satins, &c. About the year 1130, Roger II. king of Sicily, established a silk manufacture at Palermo, and another in Calabria, managed by workmen who were a part of the plunder brought from Athens, Corinth, &c. whereof that prince made a conquest in his expedition to the Holy Land. By degrees, adds Mezeray, the rest of Italy, as well as Spain, learned from the Sicilians and Calabrians the management of silk-worms, and the working of silk; and at length the French acquired it, by right of neighbourhood, a little before the reign of Francis I. and began to imitate them. Thuanus indeed, in contradiction to most other writers, makes the manufacture of silk to be introduced into Sicily two hundred years later, by Robert the Wise, king of Sicily and count of Provence.

It appears by the 33d of Henry VI. c. 5, that there was a company of *Silk-women* in England so early as the year 1455; but these were probably employed in needle-works of silk and thread; and we find that various sorts of small haberdashery of silk were manufactured here in 1482; but Italy supplied England and all other parts with the broad manufacture till the year 1489. In Spain indeed the culture and manufacture of silk seem to have been introduced at an early period by the Moors, particularly in Murcia, Cordova, and Granada. The silk-manufacturers of this last town were very flourishing when it was taken by Ferdinand, &c. at the close of the fifteenth century. In 1521, the French, being supplied with workmen from Milan, commenced a silk-manufacture; but it was long after this time before they could obtain

raw

raw silk from the worms, and even in the year 1547 silk was scarce and dear in France, and King Henry II. is said to have been the first in that country who wore a pair of silk knit stockings; though the invention originally came from Spain, whence silk stockings were brought over to Henry VIII. and Edward VI. After the civil wars in France, the planting of mulberry-trees was greatly encouraged by Henry IV. and his successors, and the produce of silk in France is at this day very considerable. The great advantage which the new manufacture afforded, made our James I. very earnest for its introduction into England; and accordingly it was recommended several times from the throne, and in the most earnest terms, particularly in the year 1608, to plant mulberry-trees for the propagation of silk-worms, but unhappily without effect; though from various experiments, recorded in the Philosophical Transactions, &c. it appears that the silkworm thrives and works as well in England as in any other part of Europe. It should not here be omitted that James I. while King of Scotland, is said to have once written to the Earl of Mar, one of his friends, to borrow a pair of silk stockings, in order to appear with becoming dignity before the English ambassador; concluding his epistle with these words: "for ye would not, sure, that your king should appear like a scrub before strangers." This shows the great rarity of silk articles at that period in Scotland; and we are told that our own Queen Elizabeth was presented by her silk-woman Mrs. Montague, with a pair of black silk stockings, with which her majesty was so captivated, that she resolved in future to wear no other stockings than silk ones.

About the year 1620 the broad silk-manufacture was introduced into this country; and in 1629 was become so considerable in London, that the silk-throwsters of the city and parts adjacent were incorporated, under the names of Master, Wardens, &c. of the silk-throwsters,

throwsters, and in 1661 this company employed above forty thousand persons. The revocation of the edict of Nantes, in 1685, contributed in a great degree to promote the silk manufacture in England, as did also the invention of the silk throwing machine at Derby in 1719. So high in reputation was the English silk-manufacture, that even in Italy, according to Keyser, the English silks bore a higher price than the Italian. *Chambers's Cycl.*

We have remarked, that some laudable attempts had been made, but without any considerable degree of success, to rear the silk-worm in Great Britain. In 1791 the public were informed, by a manufacturer in Paisley, of his having prepared a web entirely of the silk produced by worms of his own rearing: and in the Transactions of the Society for the Encouragement of Arts, vol. vii. a number of very useful experiments are recorded with regard to the food and management of these insects. Probably the want of a sufficient number of mulberry-trees has hitherto rendered ineffectual the efforts of our countrymen to introduce and rear any considerable quantity of silk-worms. From the attempts that have already been made, it appears that the white mulberry is preferable to the black in feeding, and that the latter is to be preferred to the lettuce. Twelve cocoons, the produce of worms fed upon the white mulberry, weighed seven penny-weights two grains; while an equal number of those that had been fed upon the black mulberry weighed only six penny-weights three grains: six penny-weights were obtained from the same number of worms fed upon common lettuce.

But endeavours to produce raw silk in Great Britain seem the more worthy of encouragement, as that country appears to possess some advantages of which Italy and many of the silk countries are deprived. In Italy, the chrysalides soon come to life; and it is there necessary to destroy them, lest, by eating their

way out, they should injure the silk. In order to effect this, they are collected and placed in heated ovens, where the silk, without singular caution, is apt to be damaged. In our climate, where every progression of the insect tribe is slower, there is sufficient time to wind off the silk without killing the chrysalis. But beside the injury that may be done to the silk in Italy, from the length of time which it is necessary to keep the chrysalis in these ovens, they are there obliged to suffer the moth to eat its way out of the largest cones, in order to have eggs from the most vigorous and healthy. Hence, they lose all the silk of these cones; whereas, in this country, the silk may be gathered while the moths are preserved. Thus, we seem to possess two striking advantages, which may probably compensate for the want of others which our climate has denied us.

Even the climate of England is in some respects superior to those where silk is raised. In the south of France, the frosts are often so intense as to kill the mulberry leaves after they are out: at that season of the year, this is seldom the case in South Britain; which is also more free from lightning, and those sultry heats that have always been deemed prejudicial to the silk-worm. From these considerations, the time may probably arrive, when our countrymen, by farther knowledge and experience upon this subject, may be enabled to avail themselves of these advantages, and become entitled to a rank as distinguished among the raisers, as that which they have long held among the manufacturers, of silk.

The silk-worm, however, is perhaps far from being the only insect of whose labours man might avail himself. There are many species very common, and immensely fertile, that might be beneficially employed in procuring silk, did we know how to avail ourselves of their labours. Reaumur has mentioned several whose productions ought to be subjected to experiment

ment by the manufacturer; and in some future period, some of these may be turned to account.

The GREAT TIGER-MOTH, *Phalæna caja*.

This is one of the larger English moths; and is of a fine pale cream-colour, with chocolate-brown bars and spots; the lower wings red, with black spots; the thorax chocolate-brown, with a red collar round the neck, and the body red with black bars.—The caterpillar is of a deep brown, with white specks; extremely hairy, and feeds on various plants. It changes into a chrysalis in June, and the fly appears in July.

The BROWN-TAIL MOTH, *Phalæna fuscicauda*.

A species remarkable for the ravages which its caterpillar commits, by destroying the foliage of trees and hedges, and reducing them to a perfectly bare appearance. The moth itself is about a third part less than that of a silk-worm, and is of a fine satiny white, except the hinder part of the body, which is of a deep brown. The caterpillar is brown, with ferruginous hairs, a row of white spots along each side, and two red spots on the lower part of the back: it is of a gregarious nature, vast numbers residing together under one common web: they are hatched early in autumn, from eggs laid by the parent moths, and immediately form for themselves a small web, and begin feeding on the foliage of the tree or shrub on which they were placed: they marshal themselves with great regularity for this purpose in rows, and at first devour only the upper pellicle and the green parenchyma of the leaves, and in the evening retire to their web. In about three weeks they cast their skin, and afterwards proceed to feed as before, enlarging their web from time to time, and forming it on all sides as strong and secure as possible. In this they remain the whole winter in a state of torpidity, till, being enlivened by

the warmth of the returning spring, they again issue from their covering; and, being now grown stronger, begin to devour the whole substance of the leaves, instead of contenting themselves with the upper part, as in their very young state. The destruction which they sometimes cause to the verdure of the country may be judged of by their ravages in the year 1782, when, according to the account of the ingenious Mr. Curtis, author of the *Flora Londinensis*, &c. in many parishes about London subscriptions were opened, and the poor people employed to cut off and collect the webs at one shilling per bushel, which were burned, under the inspection of the church-wardens, overseers, or beadles, of the respective parishes. At the first onset of this business Mr. Curtis assures us he was informed that fourscore bushels were collected in one day in the parish of Clapham alone. When these caterpillars are arrived at full growth, which is usually about the beginning of June, each spins itself a separate web, in which it changes to a dark-brown chrysalis, out of which in the beginning of July proceeds the moth.

The ELDER MOTH, *Phalæna sambucaria*.

Antennæ filiform, pectinate; feelers cylindrical; tongue projected, setaceous, bifid; wings tailed, angular. This is moderately large, of a pale sulphur-colour, with angular wings, marked by a narrow transverse brown line or streak. It proceeds from a green caterpillar, which like those of the rest of this section, (the *Geometra*,) walks in a peculiar manner; viz. by raising up the body at each progressive movement into the form of an arch or loop, the extremities nearly approaching each other. It changes in May and June into a black chrysalis, out of which in June or July proceeds the moth.

The

The CURRANT-BUSH MOTH, *Phalæna grossulariata*.

A beautiful insect, frequently seen in gardens in the month of July. It has somewhat the appearance of a butterfly, with rounded white wings, marked by numerous black spots; the upper pair being still farther decorated by a pair of deep yellow bands: the body also is of a deep golden yellow with black spots. The caterpillar is of similar colour; the chrysalis black.

The BRIDE MOTH, *Phalæna nupta*.

A beautiful species; the upper wings of a fine grey colour, elegantly clouded and varied with shades and lines of dark brown, &c. and the under wings of a vivid crimson, with two broad transverse black bars: the body is grey, but white underneath.—The caterpillar, which is of a pale flesh-coloured grey, is distinguished by a dorsal tubercle on the fore part of the body, and feeds chiefly on the willow: it changes to a chrysalis in July; and the moth appears in August and September.

The PADELLA MOTH, *Phalæna padella*.

Specific character, antennæ setaceous, feelers four; upper wings lead-colour, with twenty black dots. This belongs to the division *Tinea*; the species are mostly small, though often of very elegant colours. The padella is of a pearly white colour, with very numerous black spots. Its caterpillar is gregarious, appearing in great quantities on various sorts of fruit-trees during the decline of summer, and committing great ravages on the leaves: these caterpillars inhabit a common web, and usually move in large groupes together: their colour is a pale greyish yellow, with numerous black spots: each caterpillar, at the time of its change to chrysalis, envelops itself in a distinct oval web with pointed extremities, and many of these are stationed close to each other, hanging in a perpendicular

pendicular direction from the internal roof of the general enclosing web : the chrysalis is blackish, and the moth appears in the month of September. To this division also belongs

The CLOTH MOTH, *Phalæna vestianella*.

This, in its caterpillar state, is very destructive to woollen cloths, the substance of which it devours, forming for itself a tubular case with open extremities, and generally approaching to the colour of the cloth on which it is nourished. This mischievous species changes into a chrysalis in April ; and the moth, which is universally known, appears chiefly in May and June.

The FIVE-FINGERED MOTH, *Phalæna pentadactyla*.

One of the most elegant of the insect tribe, though not distinguished either by large size or lively colours. It is a small moth, of a snowy whiteness, and, at first view, catches the attention of the observer by the very remarkable aspect of its wings, which are divided into the most beautiful distinct plumes, two in each upper, and three in each under, wing, and formed on a plan resembling that of the long wing-feathers of birds, viz. with a strong middle rib or shaft, and innumerable lateral fibres. This moth appears chiefly in the month of August. Its caterpillar, which is yellowish-green, speckled with black, feeding on nettles, and changing into a blackish chrysalis enveloped in a white web.

The SIX-FINGERED MOTH, *Phalæna hexadactyla*.

In this species each wing consisting of six distinct plumes. The insect is of a pale grey-brown colour, with several transverse lines or bars across the feathers, and exhibiting a very curious spectacle in the microscope. It chiefly makes its appearance in the month of September. This little moth is by the English collectors

OF NEUROPTEROUS INSECTS. 303

collectors somewhat improperly called the Twenty-plumed Moth, the plumes being in reality twenty-four in number.

ORDER IV. NEUROPTEROUS INSECTS.

THIS order contains seven genera of insects, all of which are distinguished by four naked wings, of a reticulated structure, and by appendages springing from the extremity of the abdomen, which is unarmed with a sting: these appendages are characteristic of the male sex in this order of animals.

LIBELLULA, THE DRAGON-FLY.

OF this tribe of large insects there are 56 different species, remarkable by the formidable apparatus with which their mouths are armed. Their jaws are always more than two in number, and fitted for gratifying that voracity by which the libellulæ are distinguished. The antennæ are shorter than the thorax; the wings are always extended, and, in some measure several inches from tip to tip. The male is distinguished by a kind of hooked forceps, by which the extremity of the abdomen is terminated.

The dragon-flies, sometimes improperly called horse-flingers, are universally known, from their large size, and the frequency with which they every where appear. The organs of generation are differently situated in the male and female of this tribe: in the former, they are placed upon the under-side of that part of the abdomen which lies between the inferior wings; while, in the latter, they are found at the tip or end of the abdomen. The season of love in all insects, from the brevity of their lives, is necessarily short, but it is busily employed. It is only the large insects, such as the libellulæ, that are frequently seen celebrating the rites of Venus; and among them the operation is performed with a frequency and dispatch that seems perfectly to correspond with the transient nature

nature of their existence, and the numerous race they transmit to posterity.

The addresses of the libellula to his female seem carried on in a rough and intrepid, but efficacious, manner. He hovers about on the wing, till the object of his amours makes her appearance; he then watches an opportunity of seizing her by the head with those pincers with which his tail is armed. It is thus that the ravisher travels through the air, till the female, yielding to superior strength, perhaps to inclination, forms her body into a circle, that terminates at the genitals of the male, and thus accomplishes the great purpose of nature. It is while these kind of rapes are perpetrating, that the libellulæ are seen coupled in the air, exhibiting the form of a ring. *Barbut*, p. 205.

This insect exhibits an instance scarcely less striking than the butterfly of that strange dissimilitude in point of form under which one and the same animal is destined to appear in the different periods of its existence. Perhaps few persons not particularly conversant in the history of insects would imagine that these highly brilliant and lively animals, which may be seen flying with such strength and rapidity round the meadows, and pursuing the smaller insects with the velocity of a hawk, had once been inhabitants of the water, and that they had resided for a very long space of time in that element before they assumed their flying form. However, the female, when pregnant, retires to the side of a ditch or pond, when, by the assistance of a stick or reed, she creeps, or lowers herself down, by moving backwards, till the tip of the tail is immersed about half an inch in the water; she is then seized with a kind of trembling or shaking of the body, during which efforts she deposits a single egg in the water; afterwards she immerses her tail a second and a third time, when the same operations are performed. The tail is withdrawn from the water, by contracting
its

its annuli; and by the pressure of these upon each other, the egg is gradually forced from the ovary to the extremity of the tail, from whence it is ultimately separated, by shaking that part in the water. The eggs thus protruded by the libellulæ are of a white colour, and oblong form, resembling those produced by the *Musca vomitoria*, or common blow-fly. The caterpillar which issues from these eggs, at first feeds on small aquatic insects: gradually acquiring more voracity and boldness in the pursuit, in proportion as its strength increases, at length it becomes so insatiable that it is said to devour even those of its own kind. The form and colour of these worms are extremely disgusting: beneath the head is placed an instrument excellently adapted for seizing and holding their prey. It is furnished with a forceps at the end, and can be advanced or drawn back with all the agility of the human hand.

The caterpillar remains in the same state for nearly twelve months before it has attained to its full size: when the period of transformation has arrived, the worm repairs to the margin of its pond in quest of a convenient place of abode during the season of its inaction. It there attaches itself to a plant or piece of dry wood; and the skin, which has gradually become parched and brittle, at last splits opposite to the upper part of the thorax. Through this aperture the winged insect quickly pushes its way; and, being thus extricated from confinement, begins to expand its wings, to flutter, and finally to launch into the air, with that gracefulness and ease peculiar to this majestic tribe. The wings, however, at first, are very short, tender, and contracted, all the ramifications or fibres having been compressed within the small compass of the oblong scales on the back of the larva, or rather pupa; but in the space of about half an hour they are fully expanded, and have acquired the solidity and strength necessary for flight. This curious process of the

evolution or birth of the libellula generally takes place in the morning, and during a clear sunshine. The remaining part of the animal's life is but short in comparison with that which it passed in its aquatic state; the frosts of the close of autumn destroying the whole race. They are also the prey of several sorts of birds. It is impossible not to be struck with admiration on contemplating the changes of the libellula, which, while an inhabitant of the water, would perish by any long exposure to the air, while the complete animal, once escaped from the pupa, would as effectually be destroyed by submersion under the water, of which not an hour before, it was the legitimate or natural inhabitant. No particular time seems appointed for the metamorphosis of the libellula into its winged state; the different species are continually emerging from the water from April to August: for, as the times of copulation are various and frequent during the whole summer, so the larvæ or caterpillars are found of different sizes, according to their age. The smaller kinds, however, generally make their appearance before the largest; because, from breeding in shallow water, they sooner feel the influence of the sun on the approach of spring.

In the dragon-fly, the wonderful structure of the cornea or external coat of the eye, which prevails in by far the major part of the insect tribe, is exhibited with peculiar distinctness. Even a common magnifier, of about an inch focus, demonstrates that the cornea is marked by a prodigious number of minute decussating lines, giving a kind of chagrin or granular appearance to the whole convexity: but when microscopically examined, it exhibits a continued surface of convex hexagons, and, if cut from the head, and cleared from its internal pigment, it appears perfectly transparent, and seems to consist of an infinity of hexagonal lenses of equal convexity on both surfaces. This is a subject on which much might be said; but

it

OF NEUROPTEROUS INSECTS. 307

it may be sufficient to observe, that on each eye of this animal, according to computation of Leewenhoek, there are about twelve thousand five hundred and forty-four of these lenses.

The manners of these insects must no doubt be greatly altered by a change, which not only confers upon them a new form, but introduces them into a different element. The complete insect, in its winged state, however, still continues to pursue the same food, and remains insectivorous. The lepidopterous insects, the butterflies, and phalænæ, are destined for the support of the larger libellulæ; they are a part of those numerous tribes that are appointed to confine those prolific genera within due bounds.

The FLAT DRAGON-FLY, *Libellula depressa*.

Specific character, wings expanded when at rest, blackish at the base; abdomen depressed, yellowish at the sides. The body is short and broad. The male is of a bright sky-blue, with the sides of the body yellow; the female of a fine brown or bay, with yellow sides also. The wings in both sexes are transparent, except at the shoulders, where they are each marked by a broad bed or patch of brown with a stripe of yellow: the tips of each wing have also a small oblong-square black spot on the outer margin. The larva of this species is of a greenish brown colour.

The INDIAN DRAGON-FLY, *Libellula Indica*.

Wings varied with yellow and brown, white at the tip; lower ones with a blue spot at the base. Body green or brown. Inhabits India.

The HOOKED DRAGON-FLY, *Libellula forcipata*.

Lip equally divided; tail with three incurved claws. This is a large insect, expanding four inches and a half. The nose is yellow, having a black line on the prominent part; the thorax is black, with several broad

yellow stripes, two of which appear on the front, and two others between the ligaments of each pair of wings; the abdomen is also black, having two streaks resembling a crescent on each segment; the wings are transparent, and, but for a slight tinge of amber, almost white.

The GREAT VARIEGATED DRAGON-FLY, *Libellula grandis*.

The largest of this genus found in Britain, and perhaps not inferior in bulk to any insect which this country produces. The fore-part of the head is yellow; the eyes brown, and so very large, that they meet upon the top of the head. The thorax is dun coloured, with two oblique bands on each side, of a lemon colour. The abdomen, which is very long, is likewise of a deep buff-colour, often spotted with white upon the top and bottom of each segment; the small appendages which terminate the abdomen, are very long; the wings have more or less of a yellow complexion, and are distinguished by a brown spot on the exterior edges. This insect makes its appearance principally towards the decline of summer, and is an animal of singular beauty: its general length is about three inches from head to tail, and the wings, when expanded, measure near four inches from tip to tip: the head is very large, and affixed to the thorax by an extremely slender neck: the eyes occupy by far the greatest part of the head, and are of a pearly blue-grey cast, with a varying lustre. In its motions it is extremely rapid, flying about in pursuit of its prey during the middle of the day, and is at this time taken with extreme difficulty, darting off on the slightest alarm from the spot on which it had settled, and in the space of a second or two flying to a vast distance. During the early morning hours, and those of evening, it is easily taken: at such times it is observed to sit with its wings expanded, but in a perfectly

OF NEUROPTEROUS INSECTS: 309

fectly inert state, and will suffer itself to be readily seized by one of its wings, without attempting to stir from its place.—*Libellula varia*, Shaw.

The MAIDEN DRAGON-FLY, *Libellula virgo*.

Specific character, wings erect when at rest, eyes distinct. This is one of the most elegant of European insects. It is much smaller than the preceding, and is distinguished by its very slender long cylindrical body, which, as well as the head and thorax, is usually either of a bright but deep golden-green, or else of a deep gilded-blue. The wings are transparent at the base and tips, but are each marked in the middle by a very large oval patch or bed of deep blackish or violet-blue, accompanied with iridescent hues according to the direction of the light: sometimes the wings are entirely violet-black, without the least appearance of transparency either at the base or tips; and sometimes they are altogether transparent, without any appearance of the violet-black patch which distinguishes the majority of specimens; and lastly the insect sometimes appears with transparent wings, but shaded with a strong cast of gilded greenish brown, each being marked by a small white speck at the exterior edge, near the tip. All these varieties may often be observed in the same field, or flying within a small distance of each other on the borders of their natal stream.—The larva of this species is of a very slender form, and has the tail terminated by three large oblong-oval leaf-shaped appendages. Like those of the preceding species, it is very common in stagnant waters and in rivulets.

The DAMSEL DRAGON-FLY, *Libellula puella*.

A much smaller species than the preceding, and equally common. This varies much in colour, but is generally of a bright and beautiful sky-blue, variegated with black bars on the joints, and with the thorax

rax marked by black longitudinal stripes: the wings are transparent, and each marked near the tip with a small oblong-square black marginal spot: the head in this species, as well as in the *L. virgo*, is broader and narrower in proportion than that of the *L. grandis*, and the eyes are round, protuberant, and placed on each side at a distance from each other, instead of coalescing at the upper part, as in the *L. grandis*. This species often varies; being red or brown instead of blue. Its larva resembles that of the *L. virgo* in shape, but is proportionally smaller, and, like that, is also furnished with three large, lengthened-oval, leaf-shaped, appendages.

The LONG-BELLIED DRAGON-FLY, *Libellula linearis*.

The exotic libellulæ are very numerous: among the most remarkable may be numbered this species, which is figured in the elegant entomological work of Mr. Drury. It is a native of the Cape of Good Hope, and is distinguished by the excessive length of its slender body, which measures not less than five inches and a half in length, though scarcely exceeding the tenth of an inch in diameter. The wings are transparent, of a slender or narrow shape, as in the preceding, to which this species is allied in form, and measures five inches and a half in extent from tip to tip. The colour of the head and thorax is brown, with a yellowish stripe on each side, and the body is of a deep mazarine blue.—*L. Lucretia, Drury.*

EPHEMERA, THE DAY-FLY.

GENERIC characters, Mouth (according to Linnaeus) without mandibles; feelers four, very short, filiform. (Shaw writes, Mouth without teeth or feelers.) Antennæ short, and filiform; above the eyes are two or three stemmata; wings erect, the lower ones

OF NEUROPTEROUS INSECTS. 311

ones shortest; tail furnished some with two, some with three, bristles.

The insects of this genus have been denominated *ephemeræ*, or day-flies, from the shortness of their lives; (*ημερα*, Gr. a day;) but the life of a day is in proportion to that of several animals of this class, what the lives of the antediluvian patriarchs were to ours. The period allotted by nature for the existence of certain *ephemeræ* is only a few hours; of some, even less than an hour. This genus, like that of *libellula*, exhibits a wonderful difference between the same animal in its larva state and that of its ultimate or perfect state; the larva being altogether aquatic, the complete insect aerial. It also affords an example of what may be termed a flying pupa; since, in some species at least, the insect is no sooner evolved from the larva than it flutters to the nearest convenient spot, and again shifts its pellicle, the wings themselves having cast their exterior membrane; and this operation is so quick, that it may be rather called springing from the chrysalis than gradually emerging.

All the day-flies are produced from hexapodal worms, which are afterwards transformed into chrysalides of a form nearly resembling their own; like the parent worm, they walk on the same number of legs. Both the worm and the chrysalis are aquatic, and are provided with gills like those of fishes, and probably destined to serve the same purpose. They are seen arranged along each side of the abdomen, one on every segment, from the first to the sixth or seventh. When the insect is at rest, these branchiæ are seen moving with great rapidity; and from their position, Reaumur has distributed the chrysalides of *ephemeræ* into three distinct classes. Some of these chrysalides walk or swim up and down in the water, attach themselves to plants, or conceal themselves below the stones: others have the first pair of feet formed for digging into the ground, and besides, are provided with

two

two instruments on the forehead, still better adapted to that purpose: with these, each animal digs itself a hole on the river bank, where it constantly resides. The brinks of the Marne and the Seine in France are seen thickly perforated by these animals. The holes thus excavated are generally nearly on a level with the surface of the water, and have commonly two apertures; one by which the worm enters, and another by which it returns. These animals, while they remain in these subterraneous retreats, offer but few materials to the naturalist who would record their history: though many of them remain there for two years, and feed upon the earth in which they are lodged, yet they are effectually concealed during all that period from his observation. Probably the most interesting incidents of their lives are those which happen in our view, and are confined to the narrow space of a few hours. Their story becomes then eventful; for in that short period they are transformed into flies, the females impregnated, and the eggs deposited; and these functions are no sooner over, than the active beings who performed them finish their operations for ever.

On the banks of the Siene and the Marne, in the vicinity of Paris, the ephemera exhibit a singular spectacle for some days about the middle of August. For several hours after sunset, they rise in such vast multitudes, that they appear like the flakes pressing upon each other in a heavy fall of snow. By and by, the whole surface of the earth is covered with the swarms that have fallen upon it, after having finished their short existence. The chrysalides that remain under the water begin their transformation in the evening, and complete it by eight or nine o'clock; an operation painful and difficult to other insects, is with them performed with great celerity and apparent ease, as before hinted. No sooner has the chrysalis reached the top of the water, than its prison bursts open, and the

OF NEUROPTEROUS INSECTS. 313

the winged ephemera soars into the air. Millions after millions are thus constantly taking wing, till the air becomes darkened with their numbers: they are in that element but an instant, when abundant showers of them fall back to the ground. The females, after their fall, are busy in performing the last function of their lives, which is, depositing their eggs. Such as have dropped upon the ground leave them there; while those that have tumbled into the river produce two separate clusters of ova, each containing no less than three hundred and fifty. All this is the work only of a moment: for other insects are no sooner delivered of a single egg, than the ephemera of seven hundred. Some naturalists have pretended, that these eggs were all impregnated, like those of fishes, by a kind of sperm ejected from the body of the males. This opinion, however, is combated by Reaumur, as being attended with many difficulties. That naturalist, by the help of a lighted torch, examined these animals narrowly in their winged state; and although that method of surveying insects, whose numbers occasion so much confusion, be uncertain, he asserts, that he observed them engaged in short copulations; an assertion the more probable, since, if the ephemerae copulate, that act behoved to be more instantaneous than in any other race of beings. There are 21 species.

The COMMON DAY-FLY, OR MAY-FLY, *Ephemera vulgata*.

Specific character, three bristles to the tail; wings four, reticulate and spotted with brown. This is the largest species known, and is very plentiful in the early part of the summer about the brinks of rivulets and stagnant waters. It is of a greenish brown colour, with transparent wings elegantly mottled with brown, and is furnished at the extremity of the body with three very long black bristles. It flutters during

the evening about the surface of the water, but during the day is generally seen in a quiescent posture, with the wings closed, and applied to each other in an upright position.—The larva is of a lengthened shape, about an inch long, furnished along each side of the body with several finny plumes, and at the tail with three long feathered processes: it has also a pair of moderately long antennæ, though those of the complete insect are extremely short. When arrived at its full size, it exhibits the rudiments of wings on the back, in the form of a pair of oblong sheaths or scales: its colour is a pale yellowish or whitish brown. It is supposed to continue two years in this state of larva before it changes into the complete insect. This change takes place in the evening, when the larva rises to the surface of the water, and soon divesting itself of its skin, flies to some neighbouring object, and, after having remained some time longer, again casts its pellicle, and appears in its ultimate or perfect form, in which, as well as in its larva state, it is a favourite food of several kinds of fishes, and particularly of the trout. In some seasons it is extremely plentiful, the air in the immediate neighbourhood of its natal waters being frequently blackened by its numbers during the evening hours. We are assured by Scopoli, that such swarms are produced every season in the neighbourhood of some particular spots in the duchy of Carniola, that the countrymen think they obtain but a small portion, unless every farmer can carry off about twenty cart-loads of them into his fields, for the purpose of a manure: though what sort of carts Scopoli means by the word *currus* we do not pretend to say. They make excellent manure; but the number of animals of so small a size necessary to supply the quantity, must exceed the power of imagination to conceive.

The

OF NEUROPTEROUS INSECTS. 315

The BALANCE DAY-FLY, *Ephemera halterata*.

Tail-bristles three; upper wings white, lower wings hardly perceptible. Among the smaller species this may be considered as one of the most elegant. It is of a white colour, with the lower part of the body black: the lower wings are so very small as rather to resemble a mere pair of small membranaceous processes than real wings. It is not uncommon during the summer months. The stemmata or false eyes are in this species remarkably conspicuous, and are of a flattened surface.

The WHITE DAY-FLY, *Ephemera horacia*.

This is the species so accurately described by Swammerdam. It is of a white colour, with the anterior rib of the upper wings black or deep-brown, and the tail is furnished with two long bristles. This insect, which is common in many parts of Europe, is commemorated as a most remarkable instance of the brevity of animal life; since after its change into the perfect animal it survives but a very few hours, perishing in the course of the same evening that gave it birth. It is to be recollected however that its larva lives in its aquatic state two, and even sometimes nearly three, years; and is in this state so tenacious of life that Swammerdam assures us that one which he pierced with a pin to a board, in order to preserve it, lived all the next day notwithstanding. According to the figure given by Swammerdam, it is extremely allied to the larva of the *Eph. vulgata*, residing chiefly in tubular cavities which it forms in the mud or clay of the waters it inhabits, occasionally coming out in quest of food. In this respect it agrees with the larvæ of several others of this genus, which have a similar habit of forming tubular hollows in the banks of their native waters. When arrived at full growth, the larva, or, more properly, pupa, rises, like that of the com-

mon ephemera, to the surface of the water, generally between the hours of six and seven in the evening, and the skin of the back cracking, and springing off with an elastic motion, the fly is almost instantaneously evolved, as in the common species; after which it flies to the nearest convenient spot, and, again divesting itself of its pellicle, appears in its perfect or ultimate state. It now flies again to the water, and fluttering over its surface, as if sporting with its innumerable companions, enjoys all the pleasures of its short remainder of existence: the female breeds, deposits her eggs, and, like the male, perishes before or with the dawn of the approaching day. This species, according to Swammerdam, is extremely frequent in the mouths or entrances of the Rhine, the Maes, the Wael, the Leck, and the Isel. It appears in the fly or perfect state about midsummer, and the season of its appearance lasts only three days, none being seen again till the following year. According to Swammerdam's figure, the size of the animal is at least equal to that of the *Ephemera vulgata*, from which it principally differs in being of a white colour, and in having but two caudal bristles, though in its larva state it was furnished with three.

The TWO-WINGED DAY-FLY, *Ephemera diptera*.

A smaller species than that just mentioned; and has, as the name imports, only two wings, no traces of lower wings being discoverable. The body is brownish, and the wings white, with a strong anterior rib or border of yellow-brown, varied by cinereous spots. Having but two wings, it ought perhaps to be placed in the sixth order, that of Diptera.

WILLIAMSON'S DAY-FLY, *Ephemeron leukon*.

A species lately discovered by Dr. Williamson, and by him called the *white fly*. These insects are natives of the river Passaic, but their utmost range is not above

OF NEUROPTEROUS INSECTS. 317

above two miles and a half, and within these limits they rise in clouds, and without number. Their first appearance every year is about the 20th of July, and they continue rising every evening, more or less, about three weeks. They seek the light, for they fly in crowds to a lamp or candle. Some exist but one hour, others but half that time; in which short period they comply with the call of nature. With respect to those who live several days, there is a peculiarity observed, incident to themselves alone. They have to cast off one slough more, an operation which sometimes takes twenty-four hours to complete.

PHRYGANEÆ, THE PHRYGANEÆ.

THESE insects, as well as the last, are of a small size; but are at first sight easily distinguished by the antennæ, which are longer than the thorax, or even than the whole body. The mouth is without teeth, but furnished with four palpi or feelers; the four wings are incumbent; the under ones, when unfolded, are very broad in proportion to the size of the animal that wears them. There are 55 species ranged under this tribe, which Linnæus has divided into two families; the first characterised by having the setæ, which spring from the extremity of the abdomen, truncated like the beards of an ear of corn; and the second, by having the abdomen simple, without any bristly appendage.

The phryganææ, before they become inhabitants of the air, have, like the ephemeræ, been aquatic animals; their apartments in the water are singularly constructed; their form is that of a tube, the inward texture of which is silk, while it is outwardly composed of sand, straws, or chips of wood, and open at each extremity. The included larvæ, when feeding, protrude the head and fore-parts of the body, creeping along the bottom of the waters they inhabit by means of six short and slender legs: on the upper part of the back,

back, in most species, is situated an upright papilla or process, serving as a kind of prop or stay, preventing the case or tube from slipping too forward during the time the animal is feeding. These larvæ feed not only on the smaller water-insects, but on the spawn of fishes, and even on the young fry itself.

When the larvæ finds its chrysalis state approach, it stops up the ends of this tube with threads of a loose texture, through which the water may penetrate, while it prevents the approach of voracious insects. The precautions of these aquatic larvæ, in securing themselves in these retreats, are also necessary to protect them from fishes, who are very greedy of them. Some of the phryganæ of stagnated water, such as lakes and ponds, cut the water-lentil in regular squares, from which they construct their edifices. The common trout is one of their greatest enemies; and many other fishes covet them so eagerly, that, when stripped of their crust, they make excellent bait, and are known to fishermen by the name of *cad-bate* or *cad-dice*. The pupa resembles the perfect insect, which last is most eagerly devoured by swallows.

The DOUBLE-TAILED PHRYGANEÆ, *Ph. bicaudata*.

Specific character, two bristles at the tail, as long as the antennæ. This species frequents equally the banks of rivers and of standing pools. The wings are a third longer than the body, narrow at the top, and broad below, and reticulated with brown veins. The colour of this insect is a dark brown, with a single longitudinal streak passing across the head and thorax; the antennæ are long, filiform, and of the same colour with the legs and body.

The LARGE PHRYGANEÆ, *Ph. grandis*.

Specific character, no bristles in the tail; wings brown, testaceous, with cinereous spots. One of the largest of the European species, measuring somewhat
more

more than an inch in length, and having very much the aspect of a moth. The upper wings are grey, marked by various darker and lighter streaks and specks, and the under wings yellowish brown and semi-transparent.—The larva, which measures near an inch and three quarters in length, is of a flesh-coloured grey, with brown head and legs, and inhabits a tube composed of pieces of bark, small fragments of grass-stalks, or other substances. Like other larvæ of this genus, it is known by the name of *cade-worm*, and is frequently used by anglers as a bait. When arrived at full growth, it fastens the case or tube by several silken filaments to the stem of some water-plant, or other convenient substance, in such a manner as to project a little above the surface of the water, and, casting its skin, changes to a chrysalis of a lengthened shape, and displaying the immature limbs of the future phryganea, which in the space of about fourteen days emerges from its confinement.

The RHOMBIC PHRYGANEÆ, *Phryganea rhombica*.

A smaller species, and of a yellowish brown colour, with two obliquely-transverse rhomboid semi-transparent white spots on each upper wing; the lower wings being whitish with a tinge of yellow-brown towards the upper edge.—The larva forms its case of small pieces of the slender stems of water-grasses or other plants curiously disposed in an obliquely transverse direction; it is of a greenish brown colour, and, like the former, is found in rivulets and stagnant waters.

The JUMPING PHRYGANEÆ, *Phryganea saltatrix*.

This is one of the smallest species of the genus. The wings are hyaline, decorated each with a green and white spot. The antennæ are longer than the body; and, when examined with a microscope, appear velvety.

HEME-

HEMEROBIUS, THE HEMEROBIUS.

THIS tribe of insects has obtained the name of hemerobius (*ημερος*, a day, and *βιος*, life) from the shortness of their lives, although they continue in their winged state longer than a day. This genus is distinguished by having the mouth armed with two teeth and four palpi; the wings hang down, without being folded; the antennæ are setaceous, advanced before the head, and longer than the thorax, which is convex.

Nature seems to have spread plant-lice, *aphides*, upon almost every plant, for the maintenance of thousands of her offspring. In their larva state, the Hemorobii are great devourers of these animals; and from that circumstance they have obtained the name of *lions of plant-lice*. Even after their transformation, the hemorobii retain their carnivorous habits: not satisfied with making war upon plant-lice, who tamely suffer themselves to be devoured, they do not spare those of their own kind.

The moment these insects enter upon life, they find themselves, by the precaution of their ancestors, situated among thousands of small animals, which, without any effort, they destroy. In less than a minute after the plant-louse has been seized, the whole viscera and juices are sucked from its body. Some species make a covering for their body of the carcases which they have thus emptied, and carry them about as trophies upon their backs.

The eggs of the hemerobius offer a curious spectacle to the observer, and for a long time were deemed parasitical plants. Each of them is supported upon a long pedicle, resembling the stalk of a plant, of which the egg appeared to be the flower. In this form they are seen in clusters upon the leaves of the lime-tree in particular, where, as soon as they are hatched, they find subsistence among the surrounding plant-lice. In about fifteen days, the larva attains to its full growth,
when

OF NEUROPTEROUS INSECTS. 321

when it weaves to itself a small white silken cod of a close texture: there the hemorobius lodges about three weeks, till its metamorphosis into a winged animal is completed: if, however, the cod has not been spun till autumn, it remains in it till spring, when it is transformed. The flight of these insects is slow and heavy; some of them have an excrementitious smell. They are not, however, unsightly insects. The species are 38 in number, of which the most common as well as the handsomest is

The SPARKLING HEMEROBIUS, *H. perla*.

Specific character, wings hyaline with green veins; body yellowish green, eyes golden.

This insect is principally seen in the middle and towards the decline of summer, and is a slender-bodied fly of a grass-green colour, with bright gold-coloured eyes, and four large transparent oval wings finely reticulated with pale-green veins. The general length of the animal, from the head to the tips of the wings, is about three quarters of an inch. It is not uncommon in the neighbourhood of gardens, occasionally flying into houses. If pressed or bruised, it diffuses an odour of the most disagreeable kind, and which remains a considerable time on the fingers. The larva is of an oblong-oval shape with a pointed extremity; it grows to the length of about three quarters of an inch, and is of a flattish or slightly-convex surface, and a reddish colour: the abdominal divisions project in a serrated manner on each side the body, and the head is armed in front with a pair of short, curved, tubular, forceps, by which the animal seizes and sucks the juices of its prey. These larvæ live almost entirely on aphides, which they devour with great avidity: their growth is pretty quick, and in the space of about a fortnight they are ready to undergo their change into the chrysalis state. In order to this, the animal draws a fine silk from the extremity of its

body, and in a short space envelops itself in a round ball, of the size of a small pea, fixed to a leaf or twig of the tree it frequents, and, divesting itself of its skin, commences a chrysalis, which in the space of about twenty days affords the complete insect. It is wonderful, as Reaumur very justly observes, that an insect with such an expanse of wing should be contained within the small compass of the silken ball of the chrysalis. The complete insect, like its larva, is of a predacious nature, living on the smaller kind of flying insects.

MYRMELEON, THE LION-ANT.

GENERIC characters, Mouth furnished with jaws; teeth two; feelers four or six, elongated; stemmata none; antennæ clavated, length of thorax; wings deflected; tail of the male furnished with a forceps consisting of two straightish filaments.

Of the lion-ant, concerning which so much has been said by naturalists, there are 16 species, all distinguished by an uncommon voracity, and cunning in securing their prey; their habits of rapacity seem born with them; and during their whole lives they are supported by the game which they catch. At first sight, these animals seem but ill fitted for their manner of life: the most unwieldy insect can easily escape from them; for they cannot advance upon it a single step; all its progress in walking being backwards; by stratagem, however, this lion masters insects far superior to it in strength. In the loose sand it digs a hollow resembling a funnel, where it takes its station at the bottom, every part being concealed except the forceps with which the head is armed. This instrument, which it can open or shut at pleasure, is happily constructed for seizing and penetrating the hardest insect; and unhappy is the animal, who, in pursuing its journey, stumbles into this cavern. In vain it endeavours to scramble up by the edges, which are continually giving way

OF NEUROPTEROUS INSECTS. 323

way under its feet; it tumbles to the bottom, where it is pierced by the forceps of the lion-ant lurking below. If the insect be small, and the grains of sand, notwithstanding the declivity of the funnel, do not give way under its feet, the myrmeleon has another invention by which he renders himself master of his prey: with his head, which is flattened, he throws up repeated showers of sand from the bottom of the funnel, which falling upon the sides, force down the insect till it comes within reach. The fatal instruments with which this animal seizes its prey, are each a sort of mouth or trunk, by which it sucks out the whole entrails before it is drawn out of the body.

When the lion-ant has attained its full size, it constructs for itself an edifice, the external parts of which are particles of sand or earth combined together by silken threads: the interior cavity is lined with pure silk, white and glossy like satin. Within this ball the myrmeleon is changed into a chrysalis, of a curved or semicircular shape, displaying all the parts of the perfect insect that is soon to issue from it. After the chrysalis bursts, the winged insect which makes its escape is of a grey colour, with a long slender body, resembling the libellula. In this country, the myrmeleon is very scarce; a few, however, are found to breed among the loose earth at the bottom of walls which have a south exposure. In that dry, pulverized, and sandy, earth, their eggs are protected from rain, till they are hatched by the sun. Vallisnieri and Poupert first gave the history of the lion-ant; that of the former is in the form of a dialogue between Malpighi and Pliny, in which the modern informs the ancient naturalist of the singular manœuvres and metamorphosis of these animals.

The COMMON LION-ANT, *Myrmeleon formicarius*.

This insect, in its complete or fly state bears no inconsiderable resemblance to a small dragon-fly, from

which however it may readily be distinguished by its antennæ. It is of a predacious nature, flying chiefly by night, and pursuing the smaller insects in the manner of a libellula. It deposits its eggs in dry sandy situations, and the young larvæ, when hatched, begin separately to exercise their talent of preparing, by turning themselves rapidly round, a very small conical cavity in the sand. Under the centre of the cavity the little animal conceals itself, suddenly rushing forth at intervals in order to seize any small insect which by approaching the edge of the cavity has been so unfortunate as to fall in, and, after sucking out its juices through its tubular forceps, throws it by a sudden exertion to some distance from the cavity. As the creature increases in size it enlarges the cavity, which at length becomes about two inches or more in diameter. The larva when full-grown is more than half an inch long, and is of a flattened figure, broad towards the upper part, and gradually tapering to an obtuse point at the extremity. It is of a brown colour, and beset with numerous tufts of dusky hair, which are particularly conspicuous on each side the annuli of the abdomen. The legs are slender: the head and thorax rather small: the tubular jaws long, curved, serrated internally, and very sharp-pointed. The whole animal is of an unpleasing aspect, and on a cursory view bears a general resemblance to a flat-bodied spider. When magnified its appearance is highly uncouth. The head is broad, of a brown colour, spotted with yellow: on each side are placed two large eyes, and beneath them the antennæ, thickening towards the point, and shorter than the thorax. The neck is longer than that of most insects, and can be stretched or shortened at pleasure. The thorax is of a dirty white, and upon the annuli which compose it are seen by the microscope, the organs of respiration. This species is not found in England, but occurs in
many

OF NEUROPTEROUS INSECTS. 325

many parts of the continent, as France, Spain, Germany, &c.

Some of the extra-European species of this genus are of very considerable size, and of a highly elegant appearance.

PANORPA, THE SCORPION.

GENERIC characters, Snout horny, cylindric, with four or two feelers; stemmata three; antennæ longer than thorax; tail of the male chelated or clawed, resembling the dart of a scorpion; a circumstance from which almost all naturalists have given it that name; but this formidable instrument is not formed for any hostile purpose; it is used by him in laying hold of his female during their amorous embraces. There are nine species.

The COMMON SCORPION, *Panorpa communis*,

Is an insect very frequently seen in meadows during the early part of summer. It is a longish-bodied fly, of moderate size, with four transparent wings, elegantly variegated with deep-brown spots: the tail of the male insect, which is generally carried in an upright position, is formed by the three last segments of the abdomen, and is of a maroon colour. The wings are as long as the body. Inhabits Europe.

The GREEK SCORPION, *Panorpa Coa*.

Specific character, wings broad, erect; lower ones narrow, and very long. Inhabits Greece and the islands of the Archipelago, and is an insect of a very peculiar appearance. It is considerably larger than the preceding, and is distinguished by having the lower wings so extremely narrow or slender as to resemble a pair of linear processes with an oval dilatation at the tip, while the upper wings are very large, oval, transparent, and beautifully variegated with yellowish-brown bars and spots.—*Ephemeræ Coa*, *Hasselquist*.

RAPHI.

RAPHIDIA, THE RAPIDIA.

GENERIC characters, Mouth with two teeth; head depressed, horny; feelers four; stemmata three; wings deflected. Antennæ the length of thorax, which is cylindric and elongated in front, like the neck of a bird; tail of the female furnished with a recurved lax bristle.—In the last edition of the *Systema Naturæ* by Gmelin, only two species are assigned to this genus.

THE SERPENT RAPIDIA, *Raphidia ophiopsis*.

Specific character, wings immaculate. This has its name, *ophiopsis*, from the figure of its head, and long thorax. Its form is the most singular, perhaps, of any animal in this class of beings. The shape of the head is broad before, and narrow where it joins the thorax, resembling a heart; it is flat, smooth, and black, like horn: the thorax is of the same colour, narrow, and cylindrical: the antennæ are setaceous, and composed of many articulations: the abdomen is brown, marked with white transverse lines: the wings are radiated and diaphanous; the anus terminates in a curved setaceous bristle, about half the length of the abdomen. Inhabits Europe in woods; and preys on other insects.

THE SPOTTED RAPIDIA, *R. notata*.

A brown marginal spot on the wings; bristle in the tail of the female as long as the body. Inhabits England; supposed to be a variety of the preceding, which, except in the particulars noted above, it resembles.

ORDER V. HYMENOPTEROUS INSECTS.

THIS Order contains all the bees, hornets, wasps, and ichneumons, insects which are distinguished from those we have already reviewed, by possessing a sting, and four membranous wings. Some of them the industry of man has turned to advantage, by reducing

OF HYMENOPTEROUS INSECTS. 327

ducing them into a domestic state, while the greater part still remain the free servants of nature, and may be regarded among the most inveterate enemies which men have to dread among this race of animals. This order consists of sixteen genera.

CYNIPS, THE GALL-FLY.

GENERIC characters, Mouth armed with jaws, but has no proboscis; sting spiral, and most frequently concealed within the body; feelers four, short, unequal, capitated.

Those innumerable and various excrescences which are seen upon the leaves, branches, and roots, of trees, are all the productions of different kinds of insects. Of these, some so nearly resemble the natural productions of the plants, that they are sometimes taken for their fruit or their flowers. A particular kind of ivy produces galls that are actually eaten as fruit by the peasants in some parts of France; and in Constantinople, some of these productions are brought to market for sale.

Some of these excrescences have within a single large cavity, in which several insects live and associate together; others have a number of smaller cavities, with communications between them; a third class contain a variety of separate cells, sometimes a hundred, each occupied by a single insect, which has no communication with the rest. These productions are also of various sizes, forms, and consistency; some are spongy, while others are hard like a nut. Of the latter kind, those are best known which are imported from the Levant for the purpose of dyeing cloths.

All these apparently-monstrous productions are occasioned by the puncture of insects when depositing their eggs, or by their bite when collecting food; in both cases, the animals subsist upon it; and the more they eat, the more vigorously does the protuberance continue to grow, till at last it forms a sort of impenetrable

netrable fortress, to protect its inhabitants till they have gone through their different metamorphoses, and at last taken wing. But the best-concerted schemes of insects, and of man, are unequal to secure either from every accident that may occur. Impenetrable as the habitation of the gall-fly may appear, its walls are often perforated by other insects, who deposit eggs there, that are soon to become rapacious worms, and to lay the dwelling waste.

The ancient opinion concerning the animals found in these receptacles was, that they were spontaneously produced from the rotten wood of the plant. Afterwards, it was believed, that the roots of plants had the power of sucking up, along with sap from the earth, the eggs of insects, and that these were animated as soon as they stopped circulation through the fibres of the trees. Even Rhedi, who combated the prejudices of his age with successful boldness, had recourse to a kind of vegetative soul in plants, by which he accounted for the production of these animals. Malpighi at last explained their true origin, from eggs deposited there by those of this kind. The same naturalist gives an ingenious account of the formation of these excrescences themselves, by means of a liquor deposited by the fly, mixing with the sap of the tree, and causing a fermentation at the part. The simple extravasation of juice from the wounded plant, is however, sufficient to account for the largest galls that have yet been observed.

Of all the trees with which we are acquainted, the oak affords food and an habitation to the greatest number of insects. There are above fifty different species that in this country inhabit that tree; and probably in warmer climes the numbers of its tenants is much greater. The Norway ink, so celebrated for its colour and permanency, is the produce of a gall in that country, similar to that seen upon our oaks in the month of June. The fly which produces it is perhaps

OF HYMENOPTEROUS INSECTS. 329

perhaps the same. There are thirty-five species now known, which produce galls and excrescences on various trees; eleven of them are natives of England.

The GALL-FLY of the ROSE, *Cynips rosæ*.

This insect produces on the sweet-briar, dog-rose, &c. a gall of a highly-singular appearance, resembling a beautiful heap of finely-ramified moss, of a green colour tinged with red. This in the autumnal season is frequently observed, and, when opened, discovers in the solid fleshy or central part the included larva, in the form of a small white maggot, and sometimes several are found in different parts of the same mass. The fly itself is black, with ferruginous legs and abdomen, the latter tipped with black. The mossy gall above-mentioned, in which it is bred, is distinguished by the older writers on natural history by the title of *bedeguar*.

The OAK-LEAF GALL-FLY, *Cynips quercus folii*.

Specific character, head and body black; legs and feet chestnut-brown; wings white, but void of marginal spots. It is in the little smooth, round, hard, galls, found under the oak-leaves, generally fastened to the fibres, that this insect is produced, a single one in each gall. These latter are ligneous, of a hard compact substance, formed, like the rest, by the extravasation of the sap of the leaf, occasioned by the puncture of the gall-fly when it deposits its eggs. Sometimes, instead of the cynips, there is seen to proceed from the gall a larger insect of a brown colour, which is an ichneumon. This ichneumon is not the real inmate of the gall, or he that formed it. He is a parasite, whose mother deposited her egg in the yet tender gall; which, when hatched, brings forth a larva that destroys the larva of the cynips, and then comes out when it has undergone its metamorphosis, and acquired its wings.

The PETIOLUS GALL-FLY, *Cynips quercus petioli*.

This species is much allied to the preceding, but rather larger, and of a tawny-ferruginous cast, with the thorax marked also by black streaks. The gall produced by the puncture of this species is situated on the footstalks of oak leaves, and greatly resembles in size and appearance that of the former.

The OAK-BUD GALL-FLY, *Cynips gemmæ*.

Colour dark green, slightly gilded; antennæ and feet dun colour, rather deep. Deposits its egg in the oak-bud, which produces one of the finest galls, leafed like a rose-bud beginning to blow. When the gall is small, that great quantity of leaves is compressed, and they are set one upon another like the tiles of a roof. In the centre of the gall there is a kind of ligneous kernel, in the middle of which is a cavity; and in that is found the little larva, who feeds there, takes its growth, undergoes its metamorphosis, and at length breaks through the inclosure to get out. The whole gall is often near an inch in diameter, sometimes more when dried and displayed; and it holds to a branch by a pedicle.

The WILLOW GALL-FLY, *Cynips viminalis*.

A small species, of a yellow colour, with a black thorax. It is one of the most common of the genus, and affords one of the most familiar examples. It changes to chrysalis in the autumn, and lies in that state all winter in the fallen leaf of the willow, the perfect insect making its appearance in the succeeding spring.

TENTHREDO, THE SAW-FLY.

THE family of saw-flies have two jaws, but no trunk or proboscis. Their sting, which is almost hid by the abdomen, is of a singular structure, being composed

OF HYMENOPTEROUS INSECTS. 331

posed of two plates, and dentated like a saw. The abdomen is closely united to the thorax, without the intervention of a small stalk, as in the former and succeeding genera; feelers four, stemmata three.

From the shape of the antennæ, the tenthredines have been arranged into six tribes, consisting of 153 different species. The most remarkable fact in their history seems to be the application of her saw by the female, in cutting out a space in the twigs or buds of trees to contain her eggs. The whole process is performed with great ingenuity; and, from the tameness of these animals, may easily be observed. The eggs thus deposited have the peculiar property of increasing their size every day, till the young worms are ready to burst from them. The worm of the tenthredo has often been taken for the silk-worm; an animal which it nearly resembles, except in the feet, which are more numerous, being never less than twenty-two: like the silk-worm, too, the young tenthredo constructs a cocoon in which it may undergo its last transformation; and its edifice consists of two coats of silk, the external coarse and strong, the interior of a finer substance. The larvæ of the smaller species injure esculent vegetables, as turnips, &c.

The THIGHED SAW-FLY, *Tenthredo femorata*.

This, as the name imports, is burdened with two large thighs. The whole insect is black, except the antennæ and tarfi of the feet, which are yellow. Larva green, with a blue dorsal line and lateral yellow one. Inhabits Europe.

The YELLOW SAW-FLY, *Tenthredo lutea*.

This proceeds from a large green larva, of a finely granulated surface, with a double row of black specks along each side, and a dusky dorsal line bounded on each by yellow. It feeds on various species of willow, &c. the parchment-like case in which it envelops

itself in autumn is of a pale yellowish brown colour; and the chrysalis, which is of a pale dusky or brownish cast, exhibits the limbs of the future fly, which is equal in size to a common wasp, and is of a yellow colour, barred with black. The antennæ rather short, and strongly clavated.

The WILLOW SAW-FLY, *Tenthredo amerina*.

Smaller than the preceding, and of a cinereous brown colour, with the under part of the abdomen rufous or dull orange: like the former, its caterpillar is of a green colour, and of a finely roughened surface, powdered with numerous whitish specks. Inhabits Europe, feeding on the willow.

The ELDER SAW-FLY, *Tenthredo alni*.

Antennæ filiform, articulated. This quiet, melancholy, and beautiful, fly is found among alder plantations, and is often fatally entangled in the clammy juice that issues from their leaves. The head and trunk are of a fine yellowish brown; the antennæ a more dusky shade of the same colour, and the eyes blue. The body is coal black; the segments of a brownish yellow; the wings are of a pale yellowish brown, with little yellow risings upon their fibres, and a margin of yellow.

SIREX, THE TAILED WASP.

THE animals of this genus are not so numerous nor diversified as the last, but are greatly superior in size; the mouth is armed with two strong jaws; the palpi four, short, and articulated; the antennæ are filiform, and consist of near thirty articulations; the sting is long, stiff, ferrated, and projecting beyond the abdomen; the wings are plain, and of the shape of a lance; the abdomen is slender, terminating in a point towards the sting. The larvæ of these insects are of a lengthened cylindric appearance, living in the decayed

OF HYMENOPTEROUS INSECTS. 333

cayed parts of trees, on the substance of which they feed; but they also frequently eat their way into the bowels of other insects and their larva, living upon and consuming their vitals. But the perfect insect lives on the nectary of flowers.—There are 26 species.

The GIANT TAILED WASP, *Sirex gigas*.

Specific character, abdomen yellow at the base and tip; body black blue. This insect is larger than a hornet; the male indeed, as is frequently the case, is one third less in size than his female, and has neither spine nor sting at his extremity: that instrument, however, is formidable in the other sex; it consists of three laminæ; two at the sides, which serve for sheaths, and one in the middle, somewhat serrated, which is the real sting. The wings of this species are large, yellow, and veined; the thighs short, and black; and the legs as well as the tarsi, are yellow; the antennæ are of the same colour, and are inserted into a black head, which has apparently four eyes, but what appears to be the second pair of eyes is only two large yellow spots behind the real eyes. The belly is cylindrical, and consists of nine different segments, some of a black, and others of a yellow, colour. The larva, which measures about an inch and quarter in length, is of a yellowish white colour, and inhabits decayed firs and pines: at first view it bears some resemblance to the larvæ of the beetle tribe, but is thinner in proportion, and furnished at the tip of the abdomen with a short black spine or process. It changes to a chrysalis in July; first enveloping itself in a slight silken web of a whitish colour: the chrysalis is of a lengthened shape, with the antennæ, legs, and terminal tube or process, very distinctly characterised. If the change to chrysalis takes place in summer, the fly proceeds from it in the space of about three weeks; but if at the close of autumn, the animal continues in chrysalis the

the whole winter, emerging in the following spring. Inhabits Europe.

The **PIGMY TAILED WASP**, *Sirex pigmaeus*.

One of the smallest of the European species; being, according to Linnæus, about the size of a gnat, with a black abdomen, marked by three yellow bands, the middle of which is interrupted. It is found in Sweden.

ICHNEUMON, THE ICHNEUMON.

THIS genus contains a numerous list of insects, whose manners appear singular, even amidst the wonders which this class of beings is continually displaying. It contains 510 different species, all characterised by the antennæ, which have more than thirty articulations; by the mouth, armed with jaws, but without a tongue; feelers four; the abdomen is joined to the body by a pedicle or stalk, and which terminates in a projecting sting, inclosed in a cylindrical sheath.

We have already (p. 70.) had occasion to observe one striking peculiarity in the manners of some insects of this genus, who make their way into the body of the caterpillars of different kinds, and there deposit their eggs. It is from the signal services which they perform, in destroying caterpillars, plant-lice, and other insects, that they have derived their name: these animals are devoured by them, as the genuine ichneumon destroys the crocodiles. See vol. iii. p. 401.

As the species and varieties of the ichneumons are prodigiously numerous, so their manners are extremely diversified. In the general outlines of their character, they all agree, being remarkable for their depredations among the insect tribes. In some, the female is furnished with a wimble, attached to her abdomen; and with this instrument, though delicate, she is capable of piercing through lime and plaster. The larvæ of wasps and mason-bees are the devoted prey of this species,

OF HYMENOPTEROUS INSECTS. 335

Species, which no sooner espies one of their nests, than with its wimble it perforates the mortar of which it is constructed. This operation, which is performed with singular dexterity, is no sooner finished, than it deposits its eggs in the inside, to the number of one, two, and sometimes more. Some are contented with gluing their ova to the skin of a caterpillar, while others penetrate through it, and deposit the egg in its body. The ova hatched within the caterpillar, after being quickened into life, preys upon the intestines of that animal, without, however, destroying its vitals. Upon the life of the one animal that of the other seems to depend; and the ichneumon spares the caterpillar upon which it feeds, till it is about to enter into its chrysalis state. In the mean time, the caterpillar in which it is enclosed is apparently healthy, and prepares to undergo the same transformation; a function which it is seldom able to accomplish, because the interior parts essential to the butterfly, though not to the worm, are destroyed. Often these caterpillars, which have been the cradle of thirty or forty ichneumons, are seen fixed to the bark of a tree, as if they were sitting upon their eggs; and it is discovered that the larvæ which were within their bodies have spun their threads, with which, as with cords, the unhappy caterpillar has been fastened down, and perished miserably.

One of the most familiar examples of this process is afforded by the well-known caterpillar of the common white butterfly, which, in the autumn may be frequently observed to creep up some wall or other convenient surface, in order to undergo its own change into chrysalis; but in the space of a day or two a numerous tribe of small maggots will be seen to emerge from it, and immediately proceed to envelop themselves in distinct yellow silken cases; the whole forming a groupe around the caterpillar. Other small species of ichneumon pierce the skins of newly-changed
chrysalises

chrysalises of butterflies and moths, in which their larvæ remain during their own incomplete state. Others again are so very small that the female pierces even the eggs of moths and butterflies, and deposits her own in each. Other ichneumons are of very considerable size, and the females of these select some large caterpillar for their victim, as those of the larger Sphinges, such as the *S. ligustri*, *convolvuli*, &c. or one of the large and middle-sized moths, as the *Phalæna vinula*, *quercus*, &c. &c. These large ichneumons are generally bred in small numbers, and sometimes the female deposits but a single egg in the selected caterpillar.

The seeming severity of the process ordained by Nature for giving birth to the genus *Ichneumon*, may be much diminished by supposing, (what all the ensuing phenomena seem to imply,) that, after the first operation of piercing the skin and depositing the eggs is performed by the female ichneumon, the caterpillar feels no acute pain, the included enemies feeding only on its juices, and evidently sparing the more important organs; so that it loses its life by a very gradual decay. It was the want of an exact knowledge of the genus *Ichneumon* that proved so considerable an embarrassment to the older entomologists, who having seen a brood of ichneumons proceed from the chrysalis of a butterfly, could not but conclude that the production of insects was rather a variable and uncertain operation of Nature than a regular continuation of the same species. The observations however of Swammerdam, Malpighi, Roësel, and others, have long since removed the difficulties which formerly obscured the history of the insect tribe.

The PLANT-LOUSE *ICHNEUMON*, *I. aphidium*.

This insect is almost wholly black; the abdomen, towards the base and the feet, are yellow. This species, when about to deposit its eggs, bends the abdomen

OF HYMENOPTEROUS INSECTS. 337

men till the anus nearly approaches the thorax, and thus penetrates into the anus of the plant-louse, in which it lodges its progeny.

SPHEX, THE SAVAGE.

GENERIC characters, Mouth armed with jaws, and a few species are without a tongue; feelers four, the antennæ have ten articulations, and the wings are extended, and laid horizontally upon the back; the sting lies concealed within the body, but is strong and sharp.

This genus contains insects, perhaps the most fierce and rapacious of this class of beings. The savage, or ground-bee, does not feed upon honey, or accommodate its young with that kind of provision. They attack insects much beyond their own size, and that whether they are defenceless or armed; for they are provided with strong jaws, and a sting poisoned with a liquor fatal to every animal they engage. The savage seizes boldly on the insect he attacks, and gives it a stroke of amazing force: after this first encounter, he falls down, as if he had himself received the mortal blow; but it is only to rest from his fatigue, and to observe the effects of his prowess. By and by, the wounded animal dies; but, while yet palpitating with life, the savage devours those parts which he finds most palatable, leaving the greater part entire. It is thus that the sphex riots in the blood of hundreds of insects; and his family is no sooner increased, than the carnage becomes proportioned to the number of young he has to support. After the female has deposited her eggs in the bottom of a cell dug in the ground, or in the mud-wall of a cottage, the whole apartment is crammed with multitudes of living and dead insects, destined to be the food of the future progeny. Thus their houses, like the renowned caves of the giants, are strewed with dead. This operation is no sooner over, than the parent insects stop up the hole at the

entrance of the cell, to prevent the escape of such of the wretched captives as may yet be alive. The young, when they leave their eggs, find themselves amply supplied with provision. They devour, one after another, all the carcases with which they are provided; and when their last fly is eaten, they have no longer occasion for food, but are changed into chrysalides, which afterward become savages of one species or another, according to that of the parent pair. There are 129 species. The larvæ are without feet; the pupa has the rudiments of wings.

The POTTER SAVAGE, *Sphex figulus*.

Specific character, tongue inflected, trifid; segments of the abdomen at the edges, and lip, lucid; body smooth, black.

This is called the potter from the curious manner in which it works with clay. It inhabits Upsal, in the holes of wooden partitions abandoned by other insects; these it cleanses by gnawing round them; then, placing a bit of moist clay at the bottom, it seizes on a spider, and, having given it a mortal wound, directly sticks it upon the moist clay. In the body of this spider the female lays her egg, and then closes up the orifice of the cavity with clay. The larva, which resembles the maggot of a bee, having devoured the spider, spins itself up in a dusky silken web, and changes into a chrysalis, out of which, within a certain number of days, proceeds the complete insect, which is of a black colour, with a slightly foot stalked abdomen, the edges of the several segments being of a brighter appearance than the rest of the body. It should be added, that the female of this species prepares several separate holes or nets as above-mentioned, in each of which she places a dead insect and an egg; each cell costing her the labour of about two days.

The

OF HYMENOPTEROUS INSECTS. 339

The WANDERING SAVAGE, *Sphex viatica*.

This is also of a black colour and slightly hairy, with brown wings, and the fore-part of the abdomen ferruginous with black bands. It seizes caterpillars as the preceding does spiders, burying one in every cell in which she deposits an egg, and then closes up the cell.

AMMOPHILA, THE SAND-WASP.

THIS genus is in Turton's Linnæus separated from the preceding, on the authority of the Rev. Mr. Kerby. It contains the *Sphex fabulosa* and *arenosa*, and two more species. The generic characters are—Snout conic inflected, concealing a bifid retractile tubular tongue; jaws forcipated, three-toothed at the tip; antennæ filiform in each sex, with about fourteen articulations; eyes oval; wings plane; sting pungent, concealed in the abdomen.

The COMMON SAND-WASP, *Ammophila vulgaris*.

Specific character, antennæ of 13 joints inserted in a hollow on the front; petiole of the abdomen long, two-jointed; wings equal. This is the *Sphex fabulosa* of Linnæus and Fabricius; a black and hairy species, with the second and third joints of the abdomen ferruginous. It inhabits sandy and gravelly places, in which the female digs holes with her fore-feet, working in the manner of a dog, in order to form the cavity, in which she places either a spider or a caterpillar, after which she closes up the cavity, having first laid her egg in the dead insect.

SCOLIA, THE SCOLIA.

GENERIC characters, Mouth with a curved sharp mandible, crenate within; jaw compressed, projecting, entire and horny; tongue inflected, trifid, very short; lip projecting, membranaceous at the tip and entire;

U u 2

feelers

feelers four, equal, short, filiform; in the middle of the lip; antennæ thick, filiform, the first joint longer. There are 39 species.

The FOUR-SPOTTED SCOLIA, *Scolia quadrimaculata*.

Hairy, black; abdomen with four fulvous spots. The abdomen is oblong, the second and third segments with two round yellow spots, the edges of the segments ciliate. Wings brown with a violet gloss. Inhabits North America.—*Drury*, Pl. 39. fig. 2.

THYNNUS, THE TUNNY-FLY.

GENERIC characters, Mouth horny with an incurved mandible; the jaw short and straight: lip longer than the jaw, membranaceous at the tip, and trifid, the middle division emarginate; tongue very short, involute: feelers four, equal, filiform: antennæ cylindrical, the first joint thicker. There are four species, three of which inhabit New Holland, and were first described by Fabricius. The other is a native of Africa; and Sir Joseph Banks has specimens of each in his museum.

The DENTATED TUNNY-FLY, *Thynnus dentatus*.

Specific character, seven small denticles in the tail; abdomen black; two white dots on the second, third, and fourth, segments. Size of a common wasp. Antennæ brown, piceous at the base; lip yellow, mandibles yellow, tipped with black. Thorax black, with a yellow scutal streak before and hind-lobe, and in the middle two impressed lines.

LEUCOPSIS, THE WHITE-EYE.

GENERIC characters, Mouth horny, with short jaws; the mandible thick, and three-toothed at the tip; lip longer than the jaw, membranaceous, and emarginate at the tip; feelers four, short, equal, filiform; antennæ short, clavate: thorax with a long lanceolate

OF HYMENOPTEROUS INSECTS. 341

lanceolate scale beneath; wings folded; sting reflected and concealed in a groove of the abdomen. There are four species.

The HIGH-BACKED LEUCOPSIS, *L. dorfigera*.

Abdomen sessile, black, with two yellow bands and a dot between them. Head black. Thorax gibbous, black, with a double transverse yellow line; abdomen compressed and grooved on the back; sting double, as long as the abdomen, and reflected back into the abdominal groove. Legs yellow, spotted with black; hind-thighs toothed, with a black spot.

TIPHIA, THE TIPHIA.

GENERIC characters, Mouth with a membranaceous rounded jaw, the mandible arched and acute; no tongue; feelers four, filiform, unequal, and inserted in the middle of the lip; antennæ filiform, short, convolute; sting concealed within the abdomen. There are 27 species.

The WASP-LIKE TIPHIA, *T. vespiformis*.

Black; abdomen ferruginous, black at the base; wings blue. Head and antennæ ferruginous; wings greyish at the tip. Inhabits Malabar.

The WINGLESS TIPHIA, *T. pedestris*.

Apterous; black variegated with yellow; thorax compressed. Head above black, beneath and front yellow. Thorax yellow on the back with a black curve; breast yellow; abdomen yellow, the first four segments black with a yellow band, the fourth black with a yellow lateral spot. Tail prominent, with two ovate valves. Legs yellow; thighs compressed, carinate, black.

CHALCIS, THE NEWT-FLY.

GENERIC characters, Mouth with a horny compressed

pressed jaw; feelers four, equal; antennæ short, cylindrical, fusiform; the first joint a little thicker; thorax gibbous, lengthened behind in the place of the scutellum; abdomen rounded and slightly petiolate. There are 7 species.

The BEE-LIKE CHALCIS, *Chalcis apiformis*.

Body cinereous; abdomen black; hind-thighs thick, testaceous, with a tooth at the end. It is about the size of a common bee. The antennæ are black, ferruginous at the base. Head villous, cinereous; lip yellow, with a black streak.

The ANNULATED CHALCIS, *Chalcis annulata*.

Colour black; hind-thighs thick, toothed, with a white dot at the tip; shanks white, annulate with black. Infests the pupa of moths. Thorax subvillous, with a snowy dot before the wings; fore-legs white, the thighs with a black base, shanks with a black ring. Inhabits America.

CHRYSID, THE GOLDEN FLY.

GENERIC characters, Mouth horny, projecting; lip much longer than the jaw, which is linear, membranaceous, and emarginate at the tip; no tongue; feelers four, unequal, filiform; antennæ short, filiform, of twelve articulations, the first longer; body gilt, polished; abdomen arched beneath with a scale each side; tail generally toothed; sting pungent, nearly concealed; wings flat. There are 31 species, which are mostly found in holes of old walls.

The FLAMING GOLDEN FLY, *Chrysis ignita*.

Specific character, abdomen four-toothed at the tip. This is a common British species, and may be considered as one of the most beautiful of European insects. The fore-part of the head is green and gold, and the hinder azure. The thorax is likewise azured over,

OF HYMENOPTEROUS INSECTS. 343

over, with a mixture of green, and terminates at its extremity with sharp points on both sides. The abdomen is green and gold before, and of a coppery-red behind, imitating molten copper highly polished. The whole insect is dotted on its upper part, which gives it a great resplendency of colour. The antennæ are black, and legs green intermixed with gold. This species dwells in holes of walls between the stones, and in the mortar that cements them. It is often seen issuing from such holes, where it nestles and performs its work.—The larvæ, which resemble those of the wasp, likewise inhabit the holes of decayed walls. All the Chryses exhibit a highly-beautiful appearance under the microscope.

VESPA, THE WASP.

GENERIC characters, Mouth horny, with a compressed jaw; feelers four, unequal filiform; antennæ filiform, the first joint longer and cylindrical; eyes lunar; body glabrous; upper wings folded in each sex; sting pungent, concealed in the abdomen.

There are no less than 213 species of the wasp; many of which are universally known. The wasps in general seem to fill up a middle rank between the ichneumons and the bees; like the former, they are rapacious and carnivorous, and, like the latter, they construct hives, and sometimes feed on the produce of flowers; they devour fruit, butcher's meat, and carry on continual hostilities against almost every other species of fly: they are at once the rivals and the enemies of the common bee; many of which annually perish by their attacks.

Almost every person must have seen the establishment made under ground by the common wasp. It is a kind of subterraneous city, which at certain seasons of the year contains many thousands of inhabitants, and is constructed nearly with the same ingenuity and elegance as that of the domestic bee. Like
it,

it, it is internally formed with combs consisting of a number of hexagonal cells, all enveloped under one common covering, like coarse paper, which is constructed with great art. In this particular they excel the common bee, which contents itself with the cover afforded by the hive, or with the trunk of a rotten tree, in their wild state. Though the wasps generally make choice of some large hole under ground for the construction of their nest, they have nevertheless much labour to undergo in removing protuberances, and carrying away earth, till it is brought to that spherical figure which suits their purposes. This work completed, they next construct that paper-like covering with which the whole hive is lined. The combs in which the cells are lodged next claim their attention: these are ranged horizontally in different stories, sometimes twelve or fifteen above each other, all supported by colonades, between which the whole citizens of this subterraneous commonwealth are seen at times to walk, like men in the streets of a town.

The cells of the wasps are not constructed with that geometrical skill which has been so often admired in those of the bee; but they are not on that account the less adapted to the purposes they are destined to serve. Each comb has only a single range of cells, with their mouths opening below. They are intended, not for the reception of honey, but for the habitation of the young, which are fed twice or thrice a-day, by the morsels carried in by their parents. For the more commodious reception of their food, each of the larvæ has its head turned downward opposite to the mouth of its cell, ready to receive its meal when offered. There are, however, many varieties in the construction of wasp-hives, all suited to the views of the different species who inhabit them. Some have only a single row of cells, placed vertically, like those of the bee, and the mouths facing the sun: the reason of this variety seems to be, that some kinds require the heat of
the

OF HYMENOPTEROUS INSECTS. 345

the sun to hatch their eggs; an advantage which could not be obtained, were there more rows of cells, or were they placed in a different manner.

As in a hive of bees, so in that of wasps, there are three different kinds of animals. At certain seasons, it contains only a single female, and a number of neuters or mules, who are of no sex; at other times it contains some hundreds of females, and still a greater number of males. The former are of a size so superior to the mules, that one weighs against eight; even the male wasp is not more than half the weight of his female.

The condition of the female wasp differs widely from that of the female bee: the latter, when she leads from the parent hive a young colony, and founds a new empire, is essentially a queen; for she is more implicitly obeyed than the best of monarchs by the most loyal of his lieges. The female wasp, as her station is more laborious, so her genius seems more enterprising. Unaided by any of her kind, she lays, in the beginning of every season, the foundation of a new edifice, which is destined to be the birth place of many thousands of her species. She constructs the first cells, to which she commits the earliest of her eggs, which in time become mule-wasps, the most active and laborious of the whole race; and by these she is assisted in completing the rest of the work.

The male wasps are not so slothful as the male bee; they discharge several duties in the interior parts of the hive; but in the art of building, either the cells or the external covering, they are altogether unskilled. This falls to be executed by the mules, who carry it on with amazing dispatch. They collect together the small fibres of half-rotten wood, which they moisten with a glutinous substance, and bake up into that paper of which all their work is formed.

While these operations are carrying on by the joint labours of the hive, the mother wasp continues to lay

till she has produced fifteen or sixteen thousand neuters or mules, and about five or six hundred males and females: the commonwealth day by day increases in numbers, and enjoys peace. Towards the month of October, provisions begin to grow scarce, and a new scene ensues: this hitherto amicable tribe seems then fired with mutual rage; and the whole edifice presents one scene of massacre. The neuters and males tear from their cradles the eggs, the larvæ, and new-born insects, with undistinguishing fury. They next fight one against another. Hopes of the state, solicitude for posterity, or love to their native place, now no longer exist; the whole commonwealth is shaken to the foundation. Rains and frosts ensue; the citizens are seized with disease and languor; and happily for the other insects, and the fruit-gardens, almost the whole die. Some few females escape from the disasters of civil war, and the severity of winter, and again in the ensuing spring become the founders of new empires, which are again to be overturned.

The HORNET, *Vespa crabro*.

Specific character, a bristle on each side the lip; a double black dot at the incisures of the abdomen; thorax black, the fore-part rufous, immaculate. This is a species of a far more formidable nature than the common wasp, and is of considerably larger size: its colour is a tawny yellow with ferruginous and black bars and variegations. The nest of this species is generally built in the cavity of some decayed tree, or immediately beneath its roots; and not unfrequently in timber-yards and other similar situations. The nest however is of a smaller size than that of the wasp, though the insect be larger; and is of a somewhat globular form, with an opening beneath; the exterior shell consisting of more or fewer layers of the same strong paper-like substance with that prepared by the wasp: the cells are also of a similar nature, but much fewer

fewer in number, and less elegantly composed. The hornet, like the wasp, is extremely voracious, and preys on almost any kind of fresh animal substance which it can obtain, as well as on honey, fruit, &c. &c. Its sting is greatly to be dreaded, and is often productive of very serious consequences.

The COMMON WASP, *Vespa vulgaris*.

Specific character, distinct black dots on the abdomen, which is yellow; four yellow spots on the scutellum; thorax black, with an interrupted yellow line on each side. The nest of this species is a highly-curious structure, and is prepared beneath the surface of some dry bank or other convenient situation: its shape is that of an upright oval, often measuring ten or twelve inches at least in diameter: it consists of several horizontal stages or stories of hexagonal cells, the interstices of each story being connected at intervals by upright pillars; and the exterior surface of the nest consists of a great many layers or pieces, disposed over each other in such a manner as best to secure the interior cavity from the effects of cold and moisture: the whole nest, comprising both walls and cells, is composed of a substance very much resembling the coarser kinds of whitish-brown paper, and consists of the fibres of various dry vegetable substances, agglutinated by a tenacious fluid discharged from the mouths of the insects during their operations. The female wasps deposit their eggs in the cells, one in each cell appropriated for that purpose: from these are hatched the larvæ or maggots, which bear a near resemblance to those of bees: they are fed by the labouring wasps with a coarse kind of honey, and, when arrived at their full size, close up their respective cells with a fine tissue of silken filaments, and, after a certain period, emerge in their complete or perfect form. The male insect, like the male bee, is destitute of a sting. The society or swarm of the com-

mon wasp consists of a vast number of neutral or labouring insects, a much smaller number of males, still fewer females. They do not, like bees, prepare and lay up a store of honey for winter use, but the few which survive the season of their birth remain torpid during the colder months.

The SAXON WASP, *Vespa Holsatica*.

Two black dots on the scutellum; abdomen yellow, the upper segments black at the base. This species is about half the size of the common wasp. The elegant nest formed by this insect is sometimes seen, during the summer season, attached or hanging as it were by its base to some straw or other projecting substance; from the upper part of unfrequented buildings or outhouses. It does not much exceed the size of an egg, but is of a more globular form, and consists of several concentric bells, with considerable intervals between each, the interior alone being entire, and furnished with a small round orifice; the rest reaching only about two thirds from the base of the nest. In the centre of the complete or entire bell is situated the congeries of cells, built round a small central pillar attached to the base. The cells are not very numerous, and their orifices look downwards. Inhabits Kiel; and appears to be found also in England and France, as well as in many other parts of Europe.

APIS, THE BEE.

GENERIC characters, Mouth furnished with two jaws, and a proboscis infolded in a double sheath; wings four in number, the two foremost covering those behind when at rest: in the anus or tail of the females and working bees there is a hidden sting. The several species have each its peculiar genius, talent, manners, and disposition. Variety prevails in the order of their architecture, and in the nature of their materials. Some live in society, and share the toils; such
are

OF HYMENOPTEROUS INSECTS. 349

are the common bee and the drone. Others dwell and work in solitude, building the cradles of their families; as the leaf-cutter bee does with the rose-tree leaf; the upholsterer with the gaudy tapestry of the corn-rose; the mason-bee with a plaster, the wood-piercer with saw-dust. All are employed in their little hermitage, with a care of providing for the wants of their posterity. The species enumerated are 282, distributed by Linnæus into two assortments, viz. those in which the body of the animal is but slightly covered with fine hair or down, and those in which it is remarkably villose or hairy: the insects of the latter division are commonly distinguished by the title of *humble-bees*. The larva is without feet; hence the word *apis* has been derived from a privative, and *vous*, a foot; but by others from *apio*, to knit together, because they collect together in swarms; or from *apis*, a serpent, on account of their stings.

The COMMON BEE, *Apis mellifica*.

Specific character, pubescent; thorax greyish, abdomen brown; hind thighs ciliate, and transversely striate within.

The common or domestic honey-bee, is an insect whose history has been the subject of many volumes. Almost every writer on entomology has made the manners and economy of these animals a considerable part of his work; and many authors have treated of them, who have entered into no other department of natural history. The celebrated Reaumur, in detailing the economy of these animals, an object to which he applied himself with a perseverance superior to all mankind, has abstracted much of the marvellous from their history; but in return he has enlarged it with many facts and observations formerly unknown, and which succeeding experiments have seldom contradicted.

There are, of the domestic bee, at certain seasons
of

of the year, three kinds in every hive; the males, the females, and the bees without sex. The latter every person is acquainted with; their number is beyond comparison greater than that of the other two kinds. Nature seems to have destined them solely for the purpose of labour; and the whole drudgery of the hive lies upon them; hence they have properly been termed *working bees*, or *labourers*. It is only during one or two months of the summer, when the hive is most crowded, that males are found in it; and, even then, they do not amount to a tenth part of the whole: but they are of a superior size. During the whole course of the season, except a few days, there is only a single female to be discovered in the most numerous hive. Her fecundity, however, is so prodigious, that she is soon capable of multiplying her family to such a degree, that the hive can no longer contain it. To her the whole swarm, from ten to twenty thousand, owe their birth. Her residence is generally in the interior apartments of the lodging; when she shows herself, she is readily known by her size, being longer than even the male bees, but inferior in thickness. It is this female whom the ancients dignified with the title of *king of the bees*, and whom, with more propriety, the moderns have denominated their *queen*. From a number of well-attested experiments and observations, it appears that her life is more precious than any of the rest; for she is the soul of all their operations. If a hive is deprived of her, however numerous, it will undertake no labour; and the individuals will hardly give themselves the trouble of collecting their daily subsistence. A swarm that was busy from morning to night constructing cells and collecting wax, immediately upon this accident seem to forget that the flowers contain their food; they scarcely stir from the hive, construct no new cells, nor even finish what were begun; but the moment she is restored, their wonted spirit and activity is resumed by the whole swarm.

The

OF HYMENOPTEROUS INSECTS. 351

The external parts of bees are happily accommodated by their structure to the delicate operations they are destined to perform. Each of them is furnished with a trunk or proboscis, commonly folded up, but capable of being extended at pleasure. It is with this instrument that they collect their food; not by pumping or sucking, but by licking it from the nectaria of flowers. This proboscis, or tongue as it is sometimes called, consists of three parts respecting its length, having three articulations. First, its articulation with the head, which is in some measure similar to our larynx. Then comes the body of the tongue, which is composed of two parts; one, a kind of base, on which the other, or true tongue, is articulated. This first part is principally a horny substance, in which there is a groove, and it is articulated with the first, or larynx; on the end of this is fixed the true tongue, with its different parts. These two parts of the tongue are as it were inclosed laterally by two horny scales, one on each side, which are concave on that side next to the tongue; one edge is thicker than the other, and they do not extend so far as the other parts. Each of these scales is composed of two parts, or scales, respecting its length, one articulated with the other: the first of those scales is articulated with the common base, or larynx, at the articulation of the first part of the tongue, and incloses laterally the second part of the tongue, coming as far forwards as the third articulation: on the end of this is articulated the second scale, which continues the hollow groove that incloses the tongue laterally; this terminates in a point. These scales have some hairs on their edge. On the termination of the second part, is placed the true tongue, having two lateral portions or processes, on each side, one within the other: the external is the largest, and is somewhat similar to the before-mentioned scales. This is composed of four parts, or rather of one large part, on which three smaller are articulated,

articulated, having motion on themselves. The first, on which the others stand, is articulated at the edges of the tongue, on the basis or termination of the last-described part of the tongue: this has hairs on its edge. A little further forwards on the edges of the tongue are two small thin processes, so small as hardly to be seen with the naked eye. The middle part of all, of which these lateral parts are only appendages, is the true tongue. It is something longer than any of the before-mentioned lateral portions; and is not horny, as the other parts are, but what may be called fleshy, being soft and pliable. It is composed of short sections, which probably are so many short muscles, as in fish; for they are capable of moving it in all directions. The tongue itself is extremely villous, having some very long villi at the point, which act somewhat like capillary tubes. This whole apparatus can be folded up into a very small compass, under the head and neck. The larynx falls back into the neck, which brings the extreme end of the first portion of the tongue within the upper lip, or behind the two teeth; then the whole of the second part, which consists of five parts, is bent down upon and under this first part, and the two last scales are also bent down over the whole; so that the true tongue is inclosed laterally by the two second horny scales, and over the whole lie the two first.

The wax is not found in a perfect state upon the flowers, as many have imagined; it is there scattered upon the surface in the form of a fine powder or dust, and swept off by the hairy legs of the bee, and deposited in a hollow part of each thigh, prepared for its reception. After being carried in that form into the hive, it is all eaten up by the bee; and by the action of the stomach is brought into the state of genuine wax. From the stomach, the working bee brings it back in small parcels to the mouth like a ruminating animal; and, by chewing it there, fashions it into
pieces

OF HYMENOPTEROUS INSECTS. 353

pieces proper for the construction of the cell to which it is applied, and afterwards polished as the situation requires.

It has been observed that it is only the queen and the labourers that have *stings*; and this provision of a sting is perhaps as curious a circumstance as any attending the bee, and probably is one of the characters of the bee tribe. The apparatus itself is of a very curious construction, fitted for inflicting a wound, and at the same time conveying a poison into that wound. The apparatus consists of two piercers, conducted in a groove, or director, which appears to be itself the sting. This groove is somewhat thick at its base, but terminates in a point; it is articulated to the last scale of the upper side of the abdomen by thirteen thin scales, six on each side, and one behind the rectum. These scales inclose, as it were, the rectum or anus all round; they can hardly be said to be articulated to each other, only attached by thin membranes, which allow of a variety of motions; three of them, however, are attached more closely to a round and curved process, which comes from the basis of the groove in which the sting lies, as also to the curved arms of the sting, which spread out externally. The two stings may be said to begin by those two curved processes at their union with the scales, and converging towards the groove at its base, which they enter, then pass along it to its point. They are serrated on their outer edges, near to the point. These two stings can be thrust out beyond the groove, although not far, and they can be drawn within it; and, some think, can be moved singly. All these parts are moved by muscles, which we may suppose are very strong in them, much stronger than in other animals; and these muscles give motion in almost all directions, but more particularly outwards. It is wonderful how deep they will pierce solid bodies with the sting. They have been known to pierce the palm of the hand, which is covered with a thick cuticle, as deep as the 1-12th of an inch.

The apparatus for the poison consists of two small ducts, which are the glands that secrete the poison: these two lie in the abdomen, among the air-cells, &c. they both unite into one, which soon enters into, or forms, an oblong bag, like a bladder of urine; at the opposite end of which passes out a duct, which runs towards the angle where the two stings meet; and, entering between the two stings, is continued between them in a groove, which forms a canal by the union of the two stings to this point. There is another duct on the right of that described above, which is not so circumscribed, and contains a thicker matter, which seems to enter along with the other: but it is the first that contains the poison, which is a thin clear fluid. "To ascertain which was the poison," says Mr. John Hunter, "I dipped points of needles into both, and pricked the back of my hand; and those punctures that had the fluid from the first-described bags in them grew sore and inflamed, while the others did not. From the stings having serrated edges, it is seldom the bees can disengage them; and they immediately upon stinging endeavour to make their escape, but are generally prevented, as it were caught in their own trap; and the force they use commonly drags out the whole of the apparatus for stinging, and also part of the bowels; so that the bee most frequently falls a sacrifice immediately upon having effected its purpose."

The males, after the female is fecundated, become useless, and even offensive to the rest of the hive. The working bees, who had formerly been their nurses, and hitherto had lived with them in the best understanding, all at once break loose upon them with unrelenting fury, and in two or three days destroy the whole in one general carnage. These, however, are not the only combats in which the bees are engaged: the working bees of the same hive often quarrel, and challenge each other to battle; the one endeavouring

ing to find a place in the scaly body of his adversary into which he may thrust his sting, and the other as studiously warding off the blow. The first wound that takes place puts an end to the engagement; and the victorious bee walks off, leaving his adversary to expire in the dust. Sometimes three or four attack a single bee, without any design upon his life, but with a view to force him to disgorge his honey; and, as soon as they have succeeded, they lick it up, allowing the former proprietor to walk away. Battles are also occasioned when a neighbouring swarm, from poverty, or a principle of injustice, invade a hive already occupied. Scarcely have they entered the walls of the city, when a general engagement ensues: those who have the right of possession oppose their invaders with all their force, and with undaunted courage; not a minute passes that you do not observe a victorious bee dragging to the door of the hive a dead adversary, or one who is yet struggling in all the agonies of death. These engagements do not close but with the day; and, before victory declares for either party, they often cost thousands their lives: for very often the one who has stung its opponent leaves its weapon in the wound, an accident which proves fatal to itself.

Insects of their own species are far from being the only enemies which the bees have to fear: worms, wasps, hornets, and insects of different kinds, never fail to make their way into the hive, whenever any rent or crevice is left open. When attacked by these robbers, they perish in the unequal combat; and, when dead, their bodies are ripped up, in order to extract from them the honey they contain. Apprized of the fatal consequences of admitting them into the hive, the bees carefully fill up every chink and crevice, not with wax, but with the glutinous matter that exudes from certain trees, a substance still more tenacious. When a bee enters the hive loaded with a quantity of this stuff, it is met by others, who take small particles

of it, and apply it to the sides of the part to be stopped up, till they are entirely closed.

A swarm of bees, however numerous, as we have already seen, all owe their birth to a single female. This queen, which Virgil and the other writers of antiquity have charged with all the cares of government, is indeed busily occupied, but in functions of a different kind; and these are, the production of a vast number of eggs, which she continues to drop, one after another, into the empty cells, during a considerable part of the summer. This animal, which is so amazingly productive, on being opened, has been found to contain upwards of five thousand eggs, all of a size sufficient to be perceptible. If we make allowance for those that were already dropped, and many more not yet formed, so as to become perceptible; we shall no longer deem it incredible, that this animal should in one season become the mother of so many thousands. The most numerous hive is far inferior to the number of spawn that have been taken from the belly of a small fish.

During the whole time that the female goes from cell to cell depositing her eggs, she is accompanied by the working bees, who attend her with the most officious care. And, as the males and females are produced by her of a superior size to the rest, the working bees, as if apprized of the circumstance, construct a few cells larger than the rest; and, what is still more remarkable, the female herself knows which of the embryos are to become of her own sex, and accordingly deposits them in cells of a suitable capacity. The cell which is to contain the future queen-bee is of a structure different from all the rest; and in building it, the labourers abandon the hexagonal shape which is best adapted to the saving of labour, and of wax; nothing, in this instance, seems to cost them too dear. The cradle of their future queen consumes as much as a hundred or a hundred and fifty of the ordinary cells.

From

OF HYMENOPTEROUS INSECTS. 357

From the great number of males in each hive to a single female, the ancients were induced to believe, that fecundation among these insects was not accomplished by any act of copulation, but that it was performed by a vivifying liquor shed upon the ova in the cells. But this opinion was overthrown, as soon as it was observed, that for nine or ten months in the year there was no male in the hive. Swammerdam, who could not observe that in these animals there were any parts of generation, therefore supposed, that the female was impregnated solely by the effluvia of the male bees. The observations made by Reaumur have removed the difficulties with which this part of the history of bees seemed to be attended. The female, who is surrounded by so many males, instead of being fatigued and persecuted by their importunities, is obliged to caress and inflame the passions of these drones, who are the most cold and indifferent of all their sex. She mounts upon their backs, and pushes her gallantry to what may be deemed indecency; at length her allurements produce the desired effect, and copulation is performed. The female thus impregnated proceeds to lay her eggs, which are round and oblong, rather thicker at the one end than the other. Each is deposited in a separate cell, except upon some occasions, when the industry of the working bees has not been sufficient for the fertility of the mother: she then lays two or three in a single cell; the supernumeraries being afterwards carried away and placed by themselves, as soon as new cells are provided. The single egg which remains is fastened to the bottom of the cell by the small end, the only part which seems to touch it. In a day or two after being placed there, it produces a worm, which the working bees take care to supply with suitable food, consisting of a whitish liquor, which serves it at once for subsistence and a bed; for it lies upon it, folded up like a ring. In the space of six or seven days more, the whole

whole of its growth is completed; and the bees, who know the time at which it no longer needs to be supplied with food, cease to carry it any more. The last office which they render it, is closing up the mouth of the cell, which is done with wax. In the mean time, the young animal within, which hitherto was almost entirely inactive, begins to spin silk, and line the inside of its habitation, as a preparative to its entering into the chrysalis state, in which, for a while, it remains. Thus, in the space of about three weeks after it was first dropped into the cell, the young bee is ready to make its appearance as a winged animal. The first employment, after it has arrived at that period, is to gnaw off the wax with which the mouth of its cell had been stopped up. On its first issuing from the cell, the whole body is wet with the humid substance of the cell; but the affectionate bees flock around, and with their trunks assist in wiping off the moisture. The wings grow dry, and the limbs firm; and, in the course of the same day, it issues forth with the labourers to collect wax and honey, and thereby to make returns to the society for the care with which it has been reared.

Thus, after the commencement of summer, the number of bees daily continues to increase, till, by the month of June, they have become so numerous, that the same hive can no longer contain them. The only measure which then remains to be adopted, is to divide; and accordingly a large colony prepares to abandon for ever the place of their nativity, and to follow a young queen in forming a new establishment for themselves. It is not merely the number of bees in a hive that determines them to swarm; but that event depends upon the young female, who must not only be sufficiently strong to lean the colony, but must also be impregnated; for upon that circumstance depends the whole hopes of the future progeny. No sooner do all these predisposing circumstances concur
in

in a hive, than it prepares immediately for colonisation. In the evening before that eventful period, indication of their intention is given, by an unusual noise and hurry within the hive. All the morning of the next day passes without hardly a single bee going to collect honey. Those who are to leave the hive are preparing to take their departure; while those that remain behind defer their operations, till their companions, by their leaving them, have afforded sufficient room. It is in the great enterprize of colonisation that the influence of the queen-bee is most clearly seen. Wherever she alights, there the whole swarm take up their abode, and all cling round her body. If she is removed, they all fly in quest of her: if put into a hive where she is not placed, they either forsake it or die. Hence the art of those persons is explained who go about showing bees, making them alight on different parts of their body, and follow them for any length of time. They have possession of the queen-bee; and by that means can influence the movements of all the others.

When a swarm thus migrates from the parent hive, it frequently happens that more than one female accompanies it. The prosperity, however, of the new colony requires that there should be but one; one only is accordingly preserved. In a single day all the rest are put to death; and it is found that the one which is spared is the best entitled to reign, because she is most fertile, or nearest her period of giving a new progeny to the society. The young females in the old hive, if any remain there, share not a more happy destiny; all the supernumeraries, like those in the swarm, are put to death.

When the bees begin to work in their hives, they divide themselves into four companies: one of which roves in the fields in search of materials; another employs itself in laying out the bottom and partitions of the cells; a third is employed in making the inside
smooth,

smooth, from the corners and angles; and the fourth company brings food for the rest, or relieves those who return with their respective burdens. But they are not kept constant to one employment; they often change the tasks assigned them: those that have been at work, being permitted to go abroad; and those that have been in the fields already, take their places. They seem even to have signs, by which they understand each other: for, when any of them want food, it bends down its trunk to the bee from whom it is expected, which then opens its honey-bag, and lets some drops fall into the others mouth, which is at that time open to receive it. Their diligence and labour are so great, that, in a day's time, they are able to make cells which lie upon each other numerous enough to contain 3000 bees.

In the plan and formation of these cells they discover a most wonderful sagacity. In constructing habitations within a limited compass, an architect would have three objects in view: first, to use the smallest quantity that can be of materials; next, to give to the edifice the greatest capacity in a determined space; and thirdly, to employ the spot in such a manner that none of it may be lost. On examination, it will be found that the bees have obtained all these advantages in the hexagonal form of their cells: for, first, there is an economy of wax, as the circumference of one cell makes part of the circumferences of those contiguous to it; secondly, the economy of the spot, as those cells which join to one another leave no void between them; and thirdly, the greatest capacity or space; as, of all the figures which can be contiguous, that with six sides gives the largest area. This thriftiness prompts them to make the partitions of their cells thin; yet they are constructed so that the solidity may compensate for the scantiness of materials. The parts most liable to injury are the entrance of the cells. These the bees take care to strengthen, by adding quite

quite round the circumference of the apertures a fillet of wax, by which means this mouth is three or four times thicker than the sides: and they are strengthened at the bottom by the angle formed by the bottom of three cells falling in the middle of an opposite cell. The combs lie parallel to each other; and there is left between every one of them a space which serves as a street, broad enough for two bees to pass by each other. There are holes which go quite through the combs, and serve as lanes for the bees to pass from one comb to another, without being obliged to go a great way about. When they begin their combs, they form at the top of the hive a root or stay to the whole edifice which is to hang from it.

It is not easy to discover the particular manner of their working; for, notwithstanding the many contrivances used for this purpose, there are such numbers in continual motion, and succeed one another with such rapidity, that nothing but confusion appears to the sight. Some of them, however, have been observed carrying pieces of wax in their talons, and running to the places where they are at work upon the combs. These they fasten to the work by means of the same talons. Each bee is employed but a very short time in this way: but there is so great a number of them that go on in constant succession, that the comb increases very perceptibly. Besides these, there are others that run about beating the work with their wings and the hinder part of their body, probably with a view to make it more firm and solid.

The crude wax, when brought home by the bees to form their cells, is of as different colours as are the flowers from which it is collected: but the new combs are always of a white colour, which is afterwards changed only by the impurities arising from the steam, &c. of the bees. They likewise collect crude wax for food; for, if this were not the case,

there would be no want of wax after the combs are made: but they are observed, even in old hives, to return in great numbers loaded with such matter, which is deposited in particular cells, and is known by the name of *bee-bread*. We may guess that they consume a great deal of this substance in food by the quantity collected; which, by computation, may in some hives amount to an hundred weight in a season, whilst the real wax in such a hive does not perhaps exceed two pounds.

Honey is originally a juice digested in plants, which sweats through their pores, and chiefly in their flowers, or is contained in reservoirs in which nature stores it. The bees sometimes penetrate into these stores, and at other times find the liquor exuded. This they collect in their stomachs; so that, when loaded with it, they seem, to an inattentive eye, to come home without any booty at all.

When the bees have collected their honey, the instant they return home, they seek the cells in which they may disgorge and deposit their loads. They have two sorts of stores: one which consists of honey laid up for the winter; and the other of honey intended for accidental use in case of bad weather, and for such bees as do not go abroad in search of it. Their method of securing each of these is different. They have in each cell a thicker substance, which is placed over the honey, to prevent its running out of the cell; and that substance is raised gradually as the cell is filled, till the bees, finding that the cell cannot contain any more, close it with a covering of wax, not to be opened till times of want, or during the winter.

When the bees first settle in swarming, indeed when they at any time rest themselves, there is something very particular in their method of taking their repose. It is done by collecting themselves together in a heap, and hanging to each other by their feet. They some-
times

OF HYMENOPTEROUS INSECTS. 363

times extend these heaps to a considerable length. It would seem probable to us, that the bees from which the others hang must have a considerable weight suspended to them. All that can be said is, that the bees must find this to be a situation agreeable to themselves. They may perhaps have a method of distending themselves with air, whereby to lessen their specific gravity; in the same manner as fishes do, in order to alter their gravity compared with water. Their vigilance to counteract depredation or surprise from a foreign enemy, is highly deserving our admiration. Even during their repose, they plant centinels at the mouth of the hive, to prevent insects of any kind from getting in. But if a snail, or other large insect, should get in, notwithstanding all resistance they sting it to death; and then cover it over with a coat of *propolis*, to prevent the bad smell or maggots which might proceed from the putrefaction of such a large animal. Bees seem also to be forewarned of the appearance of bad weather by some particular feeling. It sometimes happens, even when they are assiduous and busy, that they on a sudden cease from their work; not a single one stirs out; and those that are abroad hurry home in such prodigious crowds, that the doors of their habitations are too small to admit them. It is alleged, that no bee is ever caught even in what we call a sudden shower, unless it has been at a very great distance from the hive, or has been before injured by some accident, or be sickly and unable to fly so fast as the rest. As to the age of bees, the large drones live but a little while, being destroyed without mercy so soon as the office of impregnating the queen bee is performed. Writers are not agreed as to the age of the working bees: some maintain that they are annual, and others suppose that they live many years.

It has been generally supposed, that the queen bee is the only female contained in the hive; and that the working bees are neutral, or of neither sex. But M.

Schirach has lately established a different doctrine, which has been also confirmed by the observations of Mr. Debrow, of Cambridge. According to M. Schirach, all the working or common bees are females in disguise; and the queen-bee lays only two kinds of eggs, viz. those which are to produce the drones, and those from which the working bees are to proceed: and from any one or more of these, one or more queens may be produced; so that every worm of the latter or common kind, which has been hatched about three days, is capable, under certain circumstances, of becoming the queen, or mother, of a hive. In proof of this doctrine, new and singular as it may seem, he alleges a number of satisfactory and decisive experiments, which have been since verified by those of Mr. Debrow. In the early months of the spring, and in any preceding month, even so late as November, he cut off from an old hive a piece of that part of the comb which contains the eggs of the working bees; taking care, however, that it contained likewise worms which had been hatched about three days. He fixed this in an empty hive, or box, together with a portion of honey-comb, &c. or, in other words, with a sufficiency of food and building materials, or wax, for the use of the intended colony. He then put into, and confined within, the same box, a sufficient number of common working bees, taken from the same or any other hive. As soon as the members of this small community found themselves deprived of their liberty, and without a queen, a dreadful uproar ensued, which continued generally, with some short intervals of silence, for the space of about twenty-four hours; during which time it is to be supposed they were alternately meditating and holding council on the future support of the new republic. On the final cessation of this tumult, the general and almost constant result was, that they betook themselves to work; first proceeding to the construction of a royal

OF HYMENOPTEROUS INSECTS. 365

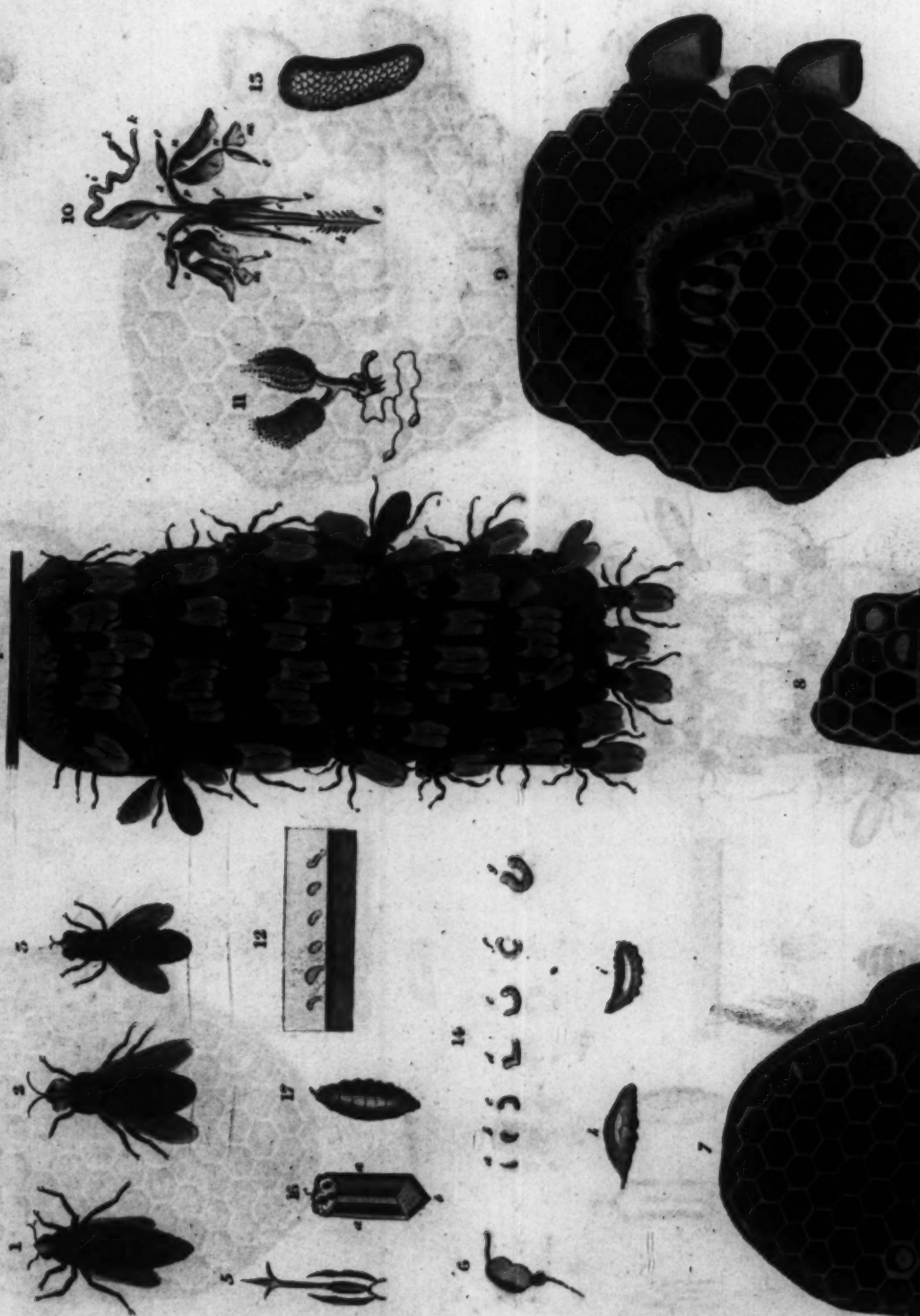
royal cell, and then taking the proper measures for hatching and feeding the brood inclosed within them. Sometimes, even on the second day the foundations of one or more royal cells were to be perceived; the view of which furnished certain indications that they had elected one of the inclosed worms to the sovereignty. The final result of this experiment is that the colony of working bees thus shut up, with a morsel of common brood, not only hatch it, but are found at the end of eighteen or twenty days, to have produced from thence one or two queens; which have apparently proceeded from worms of the common sort, pitched upon by them for that purpose; and which, under other circumstances, that is, if they had remained in the old hive, there is reason to suppose would have been changed into common working bees. In the present instance, the common worm appears to be converted by them into a queen-bee, merely because the hive was in want of one. Hence we may justly infer, that the kingdom of the bees is not, if the expression may be used, a *jure divino* or hereditary monarchy, but an elective kingdom; in which the choice of their future ruler is made by the body of the people, while she is yet in the cradle, or in embryo; and who are determined by motives of preference which will perhaps for ever elude the penetration of the most sagacious naturalists.

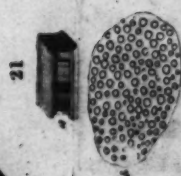
The conclusions drawn by M. Schirach, from experiments of the preceding kind, often repeated by himself and others with the same success, are, that all the common or working bees were originally of the female sex; but that, when they have undergone their last metamorphosis, they are condemned to a state of perpetual virginity, and the organs of generation are obliterated; merely because they have not been lodged, fed, and brought up, in a particular manner, while they were in the worm state. He supposes that the worm, designed by the community to be a queen, or
mother,

mother, owes its metamorphosis into a queen, partly to the extraordinary size of its cell, and its peculiar position in it; but principally to a certain appropriate nourishment found there, and carefully administered to it by the working bees while it was in the worm state; by which, and possibly other means unknown, the developement and extension of the germ of the female organs, previously existing in the embryo, is effected; and those differences in its form and size are produced, which afterwards so remarkably distinguish it from the common working bees. This discovery is capable of being applied towards forming artificial swarms, or new colonies of bees, by which means their number might be increased, and their produce in honey and wax proportionably augmented.

The annexed Plate will in some measure exhibit the structure and economy of the bee. *Fig. 1.* is the queen-bee. 2. The drone. 3. The working-bee. 4. Represents the bees hanging to each other by the feet, taking their repose. 5. The proboscis or trunk magnified, wherewith they gather the honey and take their nourishment. 6. One of the hind legs of a working-bee loaded with wax. 7. A comb in which the working-bees are bred: the cells are the smallest of any: a royal cell is suspended on one side. 8. A comb in which the drones are bred, being larger than the former; the young drones being included in several of them; with two royal cells suspended on the side. 9. A similar comb, in which the royal cell is fixed in the middle, and several common cells are sacrificed to serve as a basis and support to it; in general, the royal cells are suspended on the side of a comb, as in *fig. 7, 8.* At the side of *fig. 9.* two royal cells are begun; they resemble pretty much the cup in which an acorn lies: the other royal cells have the young queens included in them. *Fig. 10.* exhibits the sting and all its parts, magnified: the sting is

API S.





A View of the Structure and Economy of the Bee.

London: Published as the Act directed, by J. Wilson.

2. Price 10s.

OF HYMENOPTEROUS INSECTS. 357

is composed of a sheath or case, and two shanks, united to each other, and terminating in a sharp point, so as to look like a single part; *b*, the poisonous bag; *c*, the tube that conveys the poison to the sting; *dd*, the two shanks of the sting; *ee*, the sheath of the sting; *ff*, the thickest end of the sheath, where the tube opens into it with the poison; *g*, the point of the sting; *h*, the beards or jags with which the sting is armed; *i*, the tube that secretes the poison; *kk*, extremities of the tube; *lll*, cartilages which are articulated with the shanks of the sting; *mm*, two other cartilages, less than the former; *nnnn*, places where the foregoing cartilages are articulated; *oooo*, four muscles serving to move the sting different ways; *pp*, two muscles which draw the shanks of the sting into its sheath; *qq*, two appendages of the sting which are moved along with it, and seem to answer no other purpose but that of ornament. *Fig. 11.* The ovary. *12.* Six eggs drawn after nature, and placed on their ends. *13.* An egg viewed with a microscope: it resembles the skin of a fish, divested of its scales, but still retaining the marks of their insertion. *14.* Worms of bees of different sizes, drawn after nature; *a*, a worm newly hatched; *b c d e*, four worms that received more nourishment, and are more grown; *f g*, two worms still larger than the former, having had more nourishment provided for them: they are represented as they lie doubled in their cells; *h*, a worm placed on its belly, so as to show on its back a black line, which denotes the stomach; *i*, a worm lying on its back, beginning to draw in the hinder part of its body, and move its head. *Fig. 15.* A full-grown worm, viewed with a microscope; *aa*, its fourteen annular incisions or divisions; *b*, the head and eyes, &c. *c c c*, ten breathing-holes. *16.* The worm forming its web; *aa*, the sides of the cell that contain it; *b*, bottom of the cell; *c*, entrance or door of the cell: the worm is here represented as making its web to shut up this entrance.

Fig.

Fig. 17. A worm taken out of the web, and just ready to cast its skin. 18. A cell containing the worm changed into a nymph, and perfectly lined with the worm's web: likewise the web entire, with the nymph contained in it, as they appear on opening the cell; *aa*, the sides of the cell, lined with the worm's web; *b*, the mouth of the cell, closed by the web; *c*, the bottom of the cell; *d*, the web entire, as it appears on opening the cell, which it greatly resembles in form; *e*, the upper part of the web, of a convex form: this part shows its filaments pretty distinctly; *f*, the inclosed nymph appearing through the transparent sides of the web; *g*, the bottom of the web answering to that of the wax-cell.

Fig. 19. Is a worm changed to a nymph, of its natural size and form, yet so as to exhibit its limbs, which are folded up in a curious manner. 20. The nymph of the bee viewed with the microscope, displaying all the parts of the inclosed insect, and the beautiful manner in which they are laid up; *a*, the head, bloated with humours; *bb*, the eyes, projecting considerably; *cc*, the horns, or antennæ; *d*, the lip; *ee*, the teeth, or jaw-bones; *ff*, the first pair of joints belonging to the proboscis; *h*, the proboscis itself; *ii*, the first pair of legs; *kk*, two transparent little parts, lying against the lowest joints of the first pair of legs; *ll*, the second pair of legs; *mm*, the wings; *nn*, the blade bones; *oo*, the last pair of legs; *pp*, the abdominal rings; *q*, the hinder part of the body; *r*, two little parts accompanying the sting; *s*, the anus. *Fig. 21.* *a*, A cell full of bee-bread, placed in layers; *b*, little grains, of which the said substance, viewed with a microscope, appears to consist.

Of the Management of Bees.

Columella directs that the apiary face the south, and be situated in a place neither too hot nor too much exposed to the cold: that it be in a valley, in order that the loaded bees may with greater ease descend to their

OF HYMENOPTEROUS INSECTS. 369

their homes: that it be near the mansion-house, on account of the conveniency of watching them; but so situated as not to be exposed to noisome smells, or to the din of men or cattle: that it be surrounded with a wall, which however should not rise above three feet high: that, if possible, a running stream be near them; or, if that cannot be, that water be brought near them in troughs, with pebbles or small stones in the water, for the bees to rest on while they drink; or that the water be confined within gently-declining banks, in order that the bees may have safe access to it; they not being able to produce either combs, honey, or food for their maggots, without water; and that the garden in which the apiary stands be well furnished with such plants as afford the bees plenty of good pasture: Columella mentions thyme, the oak, the pine, the sweet-smelling cedar, and all fruit-trees. Experience has taught us, that furze, broom, mustard, clover, heath, &c. are excellent for this purpose: Pliny recommends broom, in particular, as a plant exceedingly grateful and very profitable to bees.

With regard to hives, those made of straw are generally preferred on several accounts: they are not liable to be over-heated by the rays of the sun: they keep out cold better than wood or any other materials; and their cheapness renders the purchase of them easy. Those who intend to erect an apiary, should purchase a proper number of hives at the latter part of the year, when they are cheapest. The hives should be full of combs, and well stored with bees. The purchaser should examine the combs in order to know the age of the hives. The combs of that season are white, those of the former year are of a darkish yellow; and, where the combs are black, the hive should be rejected, because old hives are most liable to vermin and other accidents. The summer is an improper time for buying bees, because the heat of the weather softens the wax, and thereby renders the

combs liable to break, if they are not very well secured. The honey, too, being then thinner than at other times, is more apt to run out of the cells; which is attended with a double disadvantage, namely, the loss of the honey, and the daubing of the bees, whereby many of them may be destroyed. A first and strong swarm may indeed be purchased; but leave should be obtained for them to stand in the same garden till the autumn.

Bees begin to swarm in May, or in the end of April, but earlier or later according to the warmth of the season. They seldom swarm before ten in the morning, and seldom later than three in the afternoon. When the bees of a swarm fly too high, they are made to descend lower, by throwing handfuls of sand or dust among them, which they probably mistake for rain. For the same purpose, it is usual to beat on a kettle or frying-pan: this practice may have taken its rise from observing that thunder or any great noise prompts such bees as are in the fields to return home. As soon as the swarm is settled, the bees which compose it should be got into a hive with all convenient speed, to prevent their taking wing again. If they settle on a small branch of a tree, easy to come at, it may be cut off and laid upon a cloth: the hive being ready immediately to put over them. If the branch cannot be conveniently cut, the bees may be swept off into a hive. The hive should not be immediately set on the stool where it is to remain; but should be kept near the place at which the bees settled till the evening, lest some stragglers should be lost. It should be shaded either with boughs or with a cloth, that the too-great heat of the sun may not annoy the bees.

Providence has ordained, that insects which feed on leaves, flowers, and green succulent plants, are in an insensible or torpid state from the time that the winter's cold has deprived them of the means of subsistence.

OF HYMENOPTEROUS INSECTS. 371

sistence. Thus the bees during the winter are in so lethargic a state, that little food supports them: but, as the weather is very changeable, and every warm or sunny day revives them, and prompts them to return to exercise, food becomes necessary on these occasions. Many hives of bees, which are thought to die of cold in the winter, in truth die of famine, when a rainy summer has hindered the bees from laying in a sufficient store of provisions. The hives should therefore be carefully examined in the autumn, and should then weigh at least eighteen pounds.

There is still a want of experiments to ascertain both the time and the manner in which bees should be fed. The following directions given in the *Maison Rustique* seem, however, to be very judicious. Replenish the weak hives in September with such a portion of combs full of honey taken from other hives as shall be judged to be a sufficient supply for them. In order to do this, turn up the weak hive, after taking the precaution of defending yourself with the smoke of rags, cut out the empty combs, and put the full ones in their place; where secure them with pieces of wood run across, in such manner that they may not fall down when the hive is returned to its place. The bees will soon fix them more effectually. If this method be thought too troublesome, set under the hive a plate of liquid honey, unmixed with water, with straws laid across it, and over these a paper pierced full of holes, through which the bees will suck the honey without daubing themselves. This should be done in cloudy or rainy weather, when the bees stir least abroad; and the hive should be covered, to protect the bees from robbers, who might be allured to it by the smell of the honey. Another circumstance which may render it very necessary to feed the bees is, when several days of bad weather ensue immediately after they have swarmed; for then, being destitute of every supply beyond what they carried with

them, they may be in great danger of starving. In this case, honey should be given them in proportion to the duration of the bad weather.

In this country it is usual, in seizing the stores of these little animals, to rob them also of their lives. The common method is, That when those which are doomed for slaughter have been marked out, (which is generally done in September,) a hole is dug near the hive, and a stick, at the end of which is a rag that has been dipt in melted brimstone, being stuck in that hole, the rag is set on fire, the hive is immediately set over it, and the earth is instantly thrown up all around, so that none of the smoke can escape. In a quarter of an hour, all the bees are seemingly dead; and they will soon after be irrecoverably so, by being buried in the earth that is returned back into the hole. By this last means it is that they are absolutely killed; for it has been found by experiment, that all the bees which have been affected only by the fume of the brimstone, recover again, excepting such as have been singed or hurt by the flame. Hence it is evident, that fume of brimstone might be used for intoxicating the bees, with some few precautions. The heaviest and the lightest hives are alike treated in this manner: the former, because they yield the most profit, with an immediate return; and the latter, because they would not be able to survive the winter. Those hives which weigh from fifteen to twenty pounds are thought to be the fittest for keeping. More humane and judicious methods were practised by the ancients; and successful attempts have lately been made in our own country, to attain the desirable end of getting the honey and wax without destroying the bees.

Mr. Thorley, in his Inquiry into the Nature, Order, and Government, of Bees, has this object principally in view; and he thinks colonies in boxes preferable

OF HYMENOPTEROUS INSECTS. 373

ferable to hives, for the following reasons: 1st, The more certain preservation of very many thousands of these useful creatures. 2dly, Their greater strength, which consists in numbers, and consequently their greater safety from robbers. 3dly, Their greater wealth, arising from the united labours of their greater number. He tells us, that he has in some summers taken two boxes filled with honey from one colony; and yet sufficient store has been left for their maintenance during the winter; each box weighing forty pounds. Add to these advantages, the pleasure of viewing them, with the greatest safety, at all seasons, even in their busiest time of gathering, and their requiring much less attendance in swarming time. The bees thus managed are also more effectually secured from wet and cold, from mice and other vermin. For this purpose boxes are made of deal, which, being spongy, sucks up the breath of the bees sooner than a more solid wood would do. Yellow dram-deal, thoroughly seasoned, is the best. An octagon, being nearer to a sphere, is better than a square form; for as the bees, in winter, lie in a round body near the centre of the hive, a due heat is then conveyed to all the out-parts, and the honey is kept from candying. The dimensions which Mr. Thorley recommends for the boxes, are ten inches depth, and twelve or fourteen breadth in the inside. There should be a glass-window behind, fixed in a frame, with a thin deal cover, two small brass hinges, and a button to fasten it. This window will be sufficient for inspecting the progress of the bees.

The London Society of Arts having, among their premiums for the year 1790, proposed a reward for the most satisfactory mode of managing and *preserving* bees, and for collecting honey and wax, the same was adjudged to Mr. Thomas Morris, of Isleworth, for the following Paper, addressed to that society:

“ *My Lords and Gentlemen,*—Were it the custom
to

to ornament your gardens with that useful piece of furniture, an apiary, properly situated, and carefully managed, the public might be furnished with the valuable article of honey without adulteration, and your cellars be furnished with excellent mead, little inferior to foreign white wines. Hoping that such a fashion may yet prevail in the future allotment and disposal of garden and pleasure grounds, permit me to lay before you the construction of my own apiary, and the management of my bees.

“ My hives are made in the following manner: nine inches deep, and fourteen diameter, containing each about five Winchester gallons, with a flat top made of well-seasoned deal, an inch thick; four holes at the top, one exactly over the mouth of the hive, the other three in a right angle, viz. take an inch centre-bit; make three holes as near as possible, so that you have but a small partition of wood between them; let them be made smooth and neat; then take a circular piece of half-inch board, tack it over those holes which are made in the hive, and let them be made to fit so close that no moth can get in among the young bees: so that, when a swarm is put in one of these hives in May, or the beginning of June, it soon begins to fill the hive with combs, brood, &c. which you may easily perceive by means of small pieces of glass, three inches square, put in the back of the hive, to observe their operations; and when the bees have filled their hive, and appear very busy at the mouth, open gently the hole on the top next the mouth, or rather right over the mouth, and place a glass or small hive over the hole, with proper sticks in the glass for the bees to hang their work upon; otherwise they would be a long time filling their glass, which, if they kindly take to, they will fill in twelve or fourteen days. But if your stock increases, and perhaps lies out at the mouth of the hive, you must open a second hole at the top, and then a third, and so on to the

OF HYMENOPTEROUS INSECTS: 375

the fourth, if the bees increase, and continue to lie out at the mouth: and yet many of my hives have swarmed, and left their glasses only half full of honey, in order to follow the mother bee, to settle a new colony. What I call a *mother*, most writers on bees call a *queen*; but I am satisfied she is the real mother of the whole empire and stock; and hence may be deduced that filial affection and love so conspicuous in the whole community for the mother bee, which has been vaguely and erroneously compared to the mere loyalty of subjects for their sovereign. Those stocks, the mothers of which do not breed so fast as others, of course cannot swarm so early; therefore I put on them glasses, or small hives: if the stocks so glassed keep working without swarming, you most likely will get sixteen or seventeen pounds of honey in a month's time, and save all the bees alive; and such a stock will, except by accident, make a good stock next season.

“ My hives, made as before described, have a board at the top, seventeen inches wide, that is, a full inch wider than the outside of the hive, that one may stand on another; and thus you may make complete colonies of bees with a small expence, for three hives make a complete colony. When hives are made in this manner, they cost but 12s. but, in octagon boxes, 1l. 10s. I much prefer straw hives, well made, to wooden ones, because the joints of the wood often give way, by being exposed to the weather and the sweat of the bees; and the moth-fly (the greatest enemy they have) gets in and lays her eggs in the comb, and the warmth of the bees hatches them to their own destruction; therefore straw hives are preferable, as well as cheaper than wood. My method of managing straw hives is thus: when I make use of an old straw hive, I dip it into a copper of boiling water, so that, if there should be any moth's eggs, they must

must be destroyed; but I let the hive be perfectly dry before I use it.

“ The best situation for an apiary is a little to the west of the south; for the sun, shining into the mouth of the hive too early, calls the bees abroad before the cold steam is exhaled from the flowers, and the vernal juice turned into honey: but in this situation the sun will reach the front of your apiary about nine o'clock. I would have the front leaning a little inwards, that the mouth of the hive may fit close to the mouth made in the boards, which should be three inches long in summer, and one in winter, and about one-fourth of an inch high, the better to keep out cold and the bevering moth, which you may often see, at the latter end of August, (when the working of the bees begins to decline,) standing at the mouth of the hive, bevering their wings, as if just flying in among the bees: they are then laying their eggs, and with the wind of their wings fan them within the hive; and the warmth of the bees hatches them. In October every stock should be well examined, and all the maggots brushed out, to prevent danger: for the grub or maggot forms a chrysalis, with a covering so strong, that the bees cannot displace them; and in the spring they creep out of their little sepulchres, and spin a thin web before them, as they march up into the hive among the combs; and the bees, endeavouring to dislodge them, are intangled in the web, and there die: and thus, for the want of a little trouble, many stocks are destroyed.

“ To cleanse the hive of these maggots, it must be turned up, and the dust and vermin picked out, and then gently set down in its place. If your bees are well, and in a condition to stand the winter, and have a mother with them, they will sting; otherwise not, unless you hurt them: however, a yard and a half of Scotch gauze, sewed round the brim of your hat, and

OF HYMENOPTEROUS INSECTS. 377

and then tied round the waist, having holes for your arms, will completely secure your face. The hive should also be brushed on the outside very clean, and washed all over with a sponge dipped in brine made with clean salt; a small quantity of lime and hair, made fine, should be put round the bottom, and the hives be covered with hay or hay-bands.

“ I come now to my method of feeding them, which, I think, is new. Sink a cavity in the middle of the floor, about six inches diameter, like a trencher, deep enough to hold a quarter of a pint of honey, and no more: if the cavity be too deep, the bees may be suffocated. A channel must be made from the outside of the floor, to communicate with the cavity; and a piece of wood to fit close into it, to keep out the vermin. If your bees do not weigh sixteen or seventeen pounds, exclusive of the hive, they must be fed in September, October, March, and April, and sometimes in May: they must not be fed in cold weather, for that calls them from sleep, and they then never return to the hive again: nor must they be fed in the sun-shine; for, when the honey smells strong, it sets them a quarrelling and fretting, and the strong injure the weak. The best time is evening, when I take the piece of wood out of the channel, and gently pour a quarter of a pint of honey into the cavity: if the honey will not run freely, I boil up four or five pounds with a quart of strong sweet-wort, which brings it to a proper liquid. This food will be of great service to the mothers, and make them lay eggs in abundance in the spring.

“ If a stock has been glassed two summers, it should not be worked a third; but, if it increase, take a new hive, or a clean old one, and take off all the covers from the top of the hive; let it be stuck the same as if you were to have a new swarm; place it on one of the floors; and, having opened the hole on the top nearest the back, place a piece of lath diagonally

from that hole to the side of the mouth; Tet it be made fast with pegs, not nails, lest the honey be stained; then place the old hive upon the new one, and stop the old mouth close; and the bees will then gradually work down the new hive: that will give them sufficient room for the summer. And, next spring, take another clean hive, and place the two upon it, in the same manner as before: this will serve for the next year. Now, having had no honey for two years, the upper hive will most likely be full, and may be taken away as follows: With a strong chisel separate the top hive from the other two; and in a fine day, take it away, twenty or thirty yards, and place it on the ground bottom upwards; and secure the holes on the top of the second hive. The bees no doubt will rage; but you must secure yourself with gauze, as before directed, and wear black stockings, for that colour is least observed. Place a table even with the mouth of the lowest hive, and spread a cloth over it, near the mouth, and by this time the greater part of the bees that were out will come home: the middle hive being the breeding-place, it is most likely the mother is in that; but, if she was in the top, she may yet be safe. Place a clean hive, of the same diameter as that you have taken away, upon it; then tie a cloth over both, (glasses and all, if there be any,) so tight, that the bees within may be in darkness: let them remain thus half an hour; then, with a stick, rap the bottom hive, but not so hard as to injure the combs; continue rapping half an hour; then untie the cloth, and take away the upper hive, into which the noise has driven the bees, and place it on the table and cloth from whence you took them, and shake them out on the cloth, and they will run into the mouth of their proper hive. If necessary, repeat this operation, and all the bees will be preserved: this saves the trouble and loss of smothering them with sulphur, as is the custom; and the bees, in one day, will forget the injury, and work

OF HYMENOPTEROUS INSECTS. 379

work as usual. But, in case little honey is left in their two hives, they must be fed; thus, in two hours, your honey may be taken, and the bees preserved: the honey you have obtained in this way may be dark, but will make excellent mead; but better and brighter will be produced by those which work in glasses.

“ Apiaries will not be beneficial in barren countries; but should be near gardens, shrubberies, orchards of cherries, or farms where clover, beans, saintfoin, or French wheat, grow. Lime-trees, or green-house plants, set out in the spring, and orange or lemon trees, are useful, and produce excellent honey: where there is room, it is worth while to plant gooseberries, currants, sweet marjoram, peppermint, or the like. Though I am not for preventing bees from swarming when they are inclined, yet I acknowledge that it is sometimes necessary to destroy some stocks. If they have lost their mother, and neither swarm nor work much, they should not be kept. The moth, or other accident, will sometimes spoil them, and then they should be destroyed. If bees continue in one hive for four or five years, they always degenerate, and become both fewer and weaker: the reason is, the combs for breeding are generally made on purpose, and larger than the rest; every time a bee is hatched in one, a skin or coat is left behind, which reduces the size; and in time it becomes too small to produce a bee of its proper dimensions, and occasions a necessity for their having frequently new habitations, which they will always accept, if you provide them a good situation and clean hives.”

The SMOOTH BLACK BEE, *Apis ferruginea*.

Head and thorax black; feelers, mouth, belly, and feet, of an iron colour. This is a small bee, and supposed to be of an intermediate kind between the bee and wasp. It is a native of Spain.

The CARPENTER BEE, *Apis centuncularis*.

So named from its faculty of forming long, tubular, and slightly-flexuose, cavities, in wood even of the most solid kind, as oak, &c. Sometimes it performs this operation in living trees, and sometimes in dry wood, posts, &c. The tubular cavities extend several inches in length, and are about the third of an inch in diameter, and marked into separate spaces, each of the length of three quarters of an inch. When the tube is properly finished, the animal proceeds to line each of the above-mentioned spaces with rose-leaves rolled over each other, the bottom of each being formed by several circular pieces of these leaves placed immediately over each other to a sufficient thickness. The animal then deposits an egg at the bottom, and, having left in the cell a sufficient quantity of a kind of honey for the nourishment of the young larva when hatched, proceeds to close the top with circular bits of rose-leaf; and, thus proceeding, finishes the whole series. This is usually done towards the close of summer; and the young, having passed the period of their larva state, change into that of chrysalis, and remain the whole winter, not making their appearance till pretty late in the ensuing season. This bee is about the size of the common or honey-bee, but shorter and broader-bodied in proportion, and is of a dusky colour above, the lower parts being covered with a bright-ferruginous down or hair. In seasons when this species happens to be plentiful, it does considerable injury to the trees which it attacks; large trunks of apparently healthy oaks having been found very materially injured by the numerous trains of cells distributed through it in different parts, thirty, forty, or fifty, tubes sometimes lying within a very small distance of each other. In defect of rose-leaves, the cavities are sometimes lined with the leaves of elm, &c. &c.

A spe-

OF HYMENOPTEROUS INSECTS. 381

A species very nearly allied to the preceding, pursues a similar plan of forming a continued series of cylindrical nests with rose or other leaves, rolling them in such a manner as to resemble so many thimbles, the top of each being closed as before. Instead however of being placed in the timber of trees, they are laid in horizontal trains at a certain distance beneath the surface of the ground. Mons. Reaumur, who describes this species and its nest, relates a very diverting instance of popular ignorance and superstition at that period in France. In the beginning of July 1736, the learned Abbé Nollet, then at Paris, was surprised by a visit from an auditor of the chamber of accounts, whose estate lay at a distant village on the borders of the Seine, a few leagues from Rouen. This gentleman came accompanied, among other domestics, by a gardener, whose face had an air of much concern. He had come to Paris in consequence of having found in his master's grounds many rows of leaves, unaccountably disposed in a mystical manner, and which he could not but believe were there placed by witchcraft, for the secret destruction of his lord and family. He had, after recovering from his first consternation, shown them to the curé of the parish, who was inclined to be of a similar opinion, and advised him without delay to take a journey to Paris, and make his lord acquainted with the circumstance. This gentleman, though not quite so much alarmed as the honest gardener, yet could not feel himself at perfect ease; and therefore thought it advisable to consult his surgeon upon the business, who, though a man of eminence in his profession, declared himself utterly unacquainted with the nature of what was shown him, but took the liberty of advising that the Abbé Nollet, as a philosopher, should be consulted, whose well-known researches in natural knowledge might perhaps enable him to elucidate the matter. It was in consequence of this advice that the abbé received the visit above-mentioned, and had the satisfaction

faction of relieving all parties from their embarrassment, by showing them several nests formed on a somewhat similar plan by other insects, and assuring them that those in their possession were the work of insects also. He opened some of the rose-leaf nests, showed them the inclosed larvæ, and requested permission to send the remainder to Mons. Reaumur, who pursued their investigation with much eagerness, and soon completed the natural history of the animal.

• The HUMBLE BEE, *Apis terrestris*.

Specific character, hairy, black; a yellow band on the thorax, and a yellow belt across the abdomen; tail white or yellow. The humble bees in general live in small societies of forty or sixty together, in an oval or roundish nest, excavated to a small depth beneath the surface of the ground, and formed of branches of moss, compacted together, and lined with a kind of coarse wax. In this nest, which measures from four to six inches in diameter, are constructed several oval cells, which however are not the work of the complete insects, but are the cases spun by the larvæ, and in which they remain during their state of chrysalis: the eggs are deposited among heaps of a kind of coarse honey or bee-bread, placed here and there at uncertain intervals; on this substance the larvæ feed during their growing state: lastly, in every nest are placed a few nearly cylindric cells or goblets of coarse wax, and filled with pure honey, on which feed the complete insects. Reaumur observes that humble-bees are sometimes infested with numerous small worms of the tribe of *Ascarides*. These are found in the middle of their bodies, and are enclosed in a kind of cyst or capsule. It may be added that many insects are infested with still more extraordinary inmates, viz. *Gordii* or *Filaria* of several inches in length.

OF HYMENOPTEROUS INSECTS. 383

FORMICA, THE ANT, or EMMET.

GENERIC characters, Feelers four, unequal, with cylindrical articulations, placed at the tip of the lip, which is cylindrical, and nearly membranaceous; antennæ filiform; a small erect scale between the thorax and abdomen; females and neuters armed with a concealed sting; males and females furnished with wings, neuters none.

This is a gregarious and proverbially-industrious family, consisting, like bees, of males, females, and neuters. These last are the well-known little insects, who construct the nests or ant-hills, who labour with such unremitting assiduity for the support of themselves and the idle males and females, and who guard with such serocity the larvæ, or what are commonly called ants' eggs. The nest of the ant is, in fact, a small well-regulated commonwealth, resembling in many respects that of the bees. Like them, they are continually employed in labour, and have a large proportion of the citizens neuters, whose sole employment, like that of the working bees, is collecting food for the society. The males and females have wings, and seem destined for higher enjoyments, as well as more noble occupations. Their operations are all conducted in peace, union, and good understanding; though, if we are to credit the wise man as a naturalist, they have *no guide, overseer, or ruler.* Prov. vi. 9.

When they have chosen their ground for forming an establishment, which is generally some dry and sunny exposure, all are employed in digging their retreat, to the depth of about a foot or more: they seem to take neither rest nor food till it is completed; and, to prevent disorder or confusion, their police assigns to every one his task. While one loosens the earth, another carries it away, and is met by others returning for a new load. Within this hollow cave,
when

when formed, these insects all live in society, and shelter themselves from the severity of winter. Even after the edifice is constructed, there is not a day allotted for rest, so long as the weather will permit them to go abroad. They are continually wandering about in quest of food, and carry all day each his burden into the nest. Should one chance to meet with a booty which is too large for him to remove, he is soon perceived by the rest, who come in legions to gnaw it into smaller pieces, or to assist in rolling along the unwieldy mass. Corn and seeds form an acceptable food; but, as they are also carnivorous, they devour frogs and lizards when delivered over to them, or unable to defend themselves. Their addition to animal substances is often turned to good account by anatomists, who, when they wish to obtain the skeleton of any animal too small or delicate to admit of being prepared in the usual way, dispose the animal in a proper position in a small box, with perforations in the lid, and deposit it in a large ant-hill; in consequence of which, after a certain space, the whole of the softer parts are eaten away by these insects, and the skeleton remains in its proper position. It is thus that very elegant skeletons of frogs, snakes, &c. may be obtained. Nor can this liking for animal food in the insects of this genus be said to be productive of any mischief in the European regions; but in various parts of America and the West-Indian islands the ravages committed by ants are incredible. One of the chief of these destroyers is the *F. omnivora*, a very small species of a brown or chestnut colour: it is extremely voracious, attacking every animal substance to which it can gain access. It occurs in various parts of Africa as well as in America and the West Indies, and it is said to be so numerous in some districts, that a deer, hog, &c. being killed and left on the ground at night, will by the next morning have the

OF HYMENOPTEROUS INSECTS. 385

the flesh entirely cleared from the bones, and be reduced to a complete skeleton.

Modern naturalists have asserted, that all the food collected by the ants during the day is deposited in the common cell, and devoured every evening, or distributed to the young; and that, in winter, they pass into a torpid and benumbed state, in which they are incapable of taking any food. This, however, is contradicted by the voice of all antiquity, and by Solomon himself; Prov. vi. 9. Horace recommends to the miser the example of the ant, as being noted for liberally enjoying during winter whatever had been amassed by its own industry in the mild season. We confess our incapacity to decide this matter; but having been unable, after all our researches, to find out the ants' winter store, we are rather inclined to think that in that season they either use none, or are satisfied with what they can occasionally procure.

The eggs of these insects are deposited pretty early in the spring; and, in order to provide the necessary warmth for their young, the old ants are seen carrying them out to expose them to the heat of the sun. The worms go into chrysalides, and are metamorphosed in their own skin. When about to issue forth into new life, they tear this white covering, and come forth perfect ants. The ants copulate in the air; and the females, who are the smallest of the race, seldom repair to the common habitation: what is their destiny, whether they die by the severity of the winter, or fall a sacrifice, like the bees, to the merciless fury of the labouring ants, is not ascertained.

We have already had occasion to remark the fondness of these insects for the saccharine liquor that exudes from the *aphis*, or plant-louse: it is in quest of that food that they are frequently seen on plants, in the company of these insects. In Swisserland, however, they are transported to trees for a different purpose; the destruction of caterpillars, and other vermin.

A bag filled with ants is fastened to a tree, with a small hole purposely left open for them to creep out; they spread along the tree, and are prevented from leaving it, by a quantity of pitch with which the stem is covered. Rather than die by famine, they go in pursuit of the caterpillars among the leaves, and devour them.—The ants are themselves eagerly sought after by the ant-eater, and various birds. A very grateful acid is procured from them by distillation.—There are no less than seventy species of the ant now ascertained in different parts of the world.

The GREAT WOOD-ANT, *Formica Herculanea*.

This is the largest of the European ants. It is of a chestnut colour, with the abdomen measuring two lines or more in length. This species is chiefly found in dry woods of pine or fir, where it inhabits a large conical nest or hillock, composed of dry vegetable fragments, chiefly of fir-leaves: the nest is internally distributed into several paths or tubes, converging towards the central part, and opening externally: in the middle reside the young, or larvæ, which are nursed by the neutral ants, and are occasionally brought to the surface, in order to be more within the influence of the air and sunshine for a certain time, after which they are again conveyed to the bottom or centre. When full grown, they envelop themselves in oval, white, silken cases, in which they undergo their change into chrysalis, and at length emerge in their complete form. The males and females are winged, and the females are much larger than the males.

The COMMON BLACK ANT, *Formica nigra*.

This is a well-known inhabitant of our fields and gardens, residing in great numbers beneath mole-hills and other elevated spots. It is of a brownish black colour, and of a glossy or polished surface. The eggs of this species are deposited early in the spring,

OF HYMENOPTEROUS INSECTS. 387

spring, and are extremely small, and of a white colour. From these are hatched the larvæ, which are of a thickish form, destitute of legs, and somewhat resemble in miniature the maggots of wasps and bees. They are carefully nourished by the neutral or labouring ants, till they are arrived at their full growth, when they enclose themselves in smooth, oval, pale-yellow, filken webs or cases, in which state they are popularly known by the mistaken title of *ant eggs*; the real eggs, as before observed, being white, and extremely small. It is generally in the months of June and July that the larvæ thus enclose themselves. The chrysalis, if taken out of its filken case, is of a white colour, and exhibits all the limbs of the future animal in an imperfect or contracted state. During the time of their remaining in chrysalis, the neutral ants attend them with the same care as when in their larva state, frequently shifting their situation, and placing them at greater or smaller elevations according to the different state of the atmosphere.

The GREAT-HEADED ANT, *F. cephalotes*.

Specific character, head large, double, and armed with a spine on each side behind. This is one of the largest and most remarkable of the genus: it inhabits South America, and is described as follows by Mad. Merian, who correctly figured it, and carefully watched its habits, during her residence in Surinam. "These large ants of South America will often so completely strip the trees in one night, that they seem more like naked shrubs than trees; they are armed with two curved teeth, that cut like scissars, with which they divide the petiole or foot-stalk of the leaves from the trees, while myriads of the neuters wait at the bottom for the leaves that fall, which they carry into their caves to feed their young, while in the larva or worm state. These caves are continually explored and plundered of the larvæ by the people of Surinam,

nam, who feed their poultry and chickens with them; for on this food they fatten better and quicker than on rice or barley. From these larvæ come ants, which, casting their skin, become winged, and then deposit their ova, producing these larvæ, for whose nourishment the ants toil with so much alacrity and labour in collecting leaves for food. In these hot countries, they construct their caves in the earth to the depth of eight feet, so neatly formed, and so ingeniously contrived, that one would almost suppose it the work of human art. If the neuters want to pass over to any place where there is no way, or from one limb of a tree to another, the most hardy and robust fixes his nippers fast in the branch, the second takes hold of the first, the third of the second, the fourth of the third, and in that manner hanging to one another, they expose themselves to the wind, till it carries the extreme end across, which fixes in a similar manner; and thus their bodies serve as a bridge for thousands of their companions to pass over. In some seasons, when their caves have not been much disturbed, their increase is so prodigious, that they issue from their nests in countless multitudes, attack men and cattle in their way, enter the houses, and pass in heaps through every room; till called by nature to deposit their ova for a new generation; then they depart and die."

MUTILLA, THE MUTILLA.

Generic characters, Antennæ filiform; feelers four, the articulations obconic, seated on the tip of the lip; jaw membranaceous at the tip; lip projecting, obconic. A few only are winged; in those that are provided with these instruments, they are resplendent like pearl, and laid horizontally upon the back. The body is covered with down; the thorax is retuse at the base; and the sting is concealed within the abdomen.

The

OF HYMENOPTEROUS INSECTS. 389

The common residence of the mutillæ is upon the ground, below moss, especially where there is a hollow space between the moss and the earth. They are gregarious, and, when disturbed in their retreats, make their escape by running very swiftly. In many particulars the insects of this genus resemble those of the preceding, but are of a larger size, and more lively colours. The species are 38 in number, and mostly inhabitants of foreign climes.

The SCARLET MUTILLA, *Mutilla coccinea*.

This is called *occidentalis* by Linnæus, though for what reason does not appear, as it seems to inhabit only North America, and perhaps some parts of the north of Europe. It has been noticed by Catesby and Fabricius, from the latter of whom we have adopted the epithet *coccinea*, as scarlet is the prevailing colour: there is a black band across the abdomen. The sting is filiform, and pretty long.

The BLACK MUTILLA, *M. Americana*.

An elegant species, of a black colour, with the abdomen marked on the first segment by four red spots, and on each of the rest by three large white ones, giving the appearance of three longitudinal white stripes on that part. It is a native of South America.

The YELLOW MUTILLA, *M. Europea*.

The thorax of this insect is a deep yellow, mingled with black velvety down: the prevailing colour of the abdomen is black, but is adorned with two, and sometimes a greater number of, yellowish white bands. The antennæ are black, and bending; the legs of the same colour, and hairy; the eyes are of a beautiful pearl white, shining from a head of a coal black. Inhabits Europe, in woods and fields, beneath moss, &c. measures about half an inch in length. It appears to live

live in small societies in the manner of ants, some individuals being winged, and others apterous.

ORDER VI. DIPTEROUS INSECTS.

THIS Order comprehends all the numerous races of flies, tipulæ, and gnats, which are characterised by having only *two wings*: below each of these there is placed a balance or poiser, which is terminated by a knob, and has its base concealed under a little scale. This order contains twelve genera.

CÆSTRUS, THE GAD-FLY.

GENERIC characters, Mouth with a simple aperture, and not exerted; feelers two, of two articulations, orbicular at the tip, and seated each side in a depression of the mouth; antennæ of three articulations, the last sub-globular, and furnished with a bristle on the fore-part; placed in two hollows on the front.

The face of this singular genus is broad, depressed, vesicular, and glaucous, and has some sort of resemblance to the ape-kind. They are extremely troublesome to horses, sheep, and cattle, depositing their eggs in different parts of the body, and producing painful tumours, and sometimes death. The larvæ are without feet, short, thick, soft, and annulate, and often furnished with small hooks. There are 12 species, of which we have already described six at p. 69 of this volume. But we are enabled to add a more recent and correct account of

The HORSE GAD-FLY, *Cæstrus equi*.

This insect has been extremely well described by Mr. Bracy Clark in the 3d vol. of the Transactions of the Linnæan Society. It is smaller than the *bovis*; and of a yellowish brown colour, with a dusky band across the thorax, and the tip of the abdomen of similar colour; the wings are whitish, with a pale-dusky bar

bar across the middle of each, and two dusky spots at the tip.

The manner in which the young larvæ, or bots, are introduced into the stomach and bowels of the animal they infest is singularly curious, and cannot be better delivered than in the words of the ingenious observer.

“ When the female has been impregnated, and the eggs are sufficiently matured, she seeks among the horses a subject for her purpose, and approaching it on the wing, she holds her body nearly upright in the air, and her tail, which is lengthened for the purpose, curved inwards and upwards; in this way she approaches the part where she designs to deposit her egg; and suspending herself for a few seconds before it, suddenly darts upon it, and leaves her egg adhering to the hair: she hardly appears to settle, but merely touches the hair with the egg held out on the projected point of the abdomen. The egg adheres by means of a glutinous liquor secreted with it. She then leaves the horse at a small distance, and prepares a second egg, and, poising herself before the part, deposits it in the same way. The liquor dries, and the egg becomes firmly glued to the hair: this is repeated by various flies till four or five hundred eggs are sometimes placed on one horse. The horses, when they become used to this fly, and find that it does them no injury by sucking their blood, hardly regard it, and do not appear at all aware of its insidious object. The skin of the horse is always thrown into a tremulous motion on the touch of this insect, which merely arises from the very great irritability of the skin, and cutaneous muscles at this season of the year, August and September, occasioned by the continual teasing of the flies, till at length these muscles act involuntarily on the slightest touch of any body whatever. The inside of the knee is the part on which these flies are most fond of depositing their eggs, and next to this on the side and back part of the shoulder,

and

and less frequently on the extreme ends of the mane; but it is a fact worthy of attention, that the fly does not place them promiscuously about the body, but constantly on those parts which are most liable to be licked with the tongue; and the ova therefore are always scrupulously placed within its reach. The eggs thus deposited, I at first supposed were loosened from the hairs by the moisture of the tongue, aided by its roughness, and were conveyed to the stomach, where they were hatched;" [and so we had stated it, p. 69.] "but on more minute search I do not find this to be the case, or at least only by accident; for, when they have remained on the hairs four or five days, they become ripe, after which time the slightest application of warmth and moisture is sufficient to bring forth in an instant the latent larva. At this time, if the tongue of the horse touches the egg, its operculum is thrown open, and a small active worm is produced, which readily adheres to the moist surface of the tongue, and is from thence conveyed with the food to the stomach. If the egg itself be taken up by accident, it may pass on to the intestinal canal before it hatches; but in this case its existence to the full growth is more precarious, and certainly not so agreeable, as it is exposed to the bitterness of the bile. I have often with a pair of scissors clipped off some hairs with eggs on them from the horse, and, on placing them in the hand moistened with saliva, they have hatched in a few seconds. At other times, when not perfectly ripe, the larva would not appear, though held in the hand under the same circumstances for several hours; a sufficient proof that the eggs themselves are not conveyed to the stomach.

"It is fortunate for the animals infested by these insects, (adds Mr. Clark,) that their numbers are limited by the hazards they are exposed to. I should suspect near a hundred are lost for one that arrives at the perfect state of a fly. The eggs, in the first place, when

when ripe, often hatch of themselves, and the larva, without a nidus, crawls about till it dies; others are washed off by the water, or are hatched by the sun and moisture, thus applied together. When in the mouth of the animal, they have the dreadful ordeal of the teeth and mastication to pass through. On their arrival at the stomach, they may pass, mixed with the mass of the food, into the intestines; and when full grown, on dropping from the anus to the ground, a dirty road or water may receive them. If on the commons, they are in danger of being crushed to death, or of being picked up by the birds who so constantly for food attend the footsteps of the cattle. Such are the contingencies by which Nature has wisely prevented the too great increase of their numbers, and the total destruction of the animals they feed on."

These larvæ attach themselves to every part of the stomach, but are generally most numerous about the pylorus, and are sometimes, though much less frequently, found in the intestines. Their numbers in the stomach are very various, often not more than half a dozen, at other times more than a hundred, and, if some accounts might be relied on, even a much greater number than this. They hang most commonly in clusters, being fixed by the small end to the inner membrane of the stomach, which they adhere to by means of two small hooks or tentacula. When they are removed from the stomach, they will attach themselves to any loose membrane, and even to the skin of the hand. The body of the larva is composed of eleven segments, all of which, except the two last, are surrounded with a double row of horny bristles directed towards the truncated end, and are of a reddish colour, except the points, which are black. These larvæ evidently receive their food at the small end, by a longitudinal aperture, which is situated between two hooks or tentacula. Their food is probably the chyle, which, being nearly pure aliment, may go

wholly to the composition of their bodies without any excrementitious residue, though on dissection the intestine is found to contain a yellow or greenish matter, which is derived from the colour of the food, and shows that the chyle, as they receive it, is not perfectly pure. They attain their full growth about the latter end of May, and are coming from the horse from this time to the latter end of June, or sometimes later. On dropping to the ground they find out some convenient retreat, and change to the chrysalis; and in about six or seven weeks the fly appears.

M. Latreille, in his Nat. Hist. of Insects, now publishing at Paris, observes, "that the gad-flies which attack animals are always females, and that males have never been found among them. The same circumstance has been remarked with regard to the gnat; no male of which has been known to bite." This (if really a fact) is a new discovery in natural history.

The most successful method of obtaining the flies from the chrysalis is by taking the larvæ, when fresh dropped from the horse, and immediately enclosing them separately in balls of fresh horse-dung, which must be kept in a warm situation, and sprinkled every second or third day with water: the animals will thus be preserved in a proper degree of warmth and moisture, and the flies will make their appearance in the usual time. The complete insect is shown on the large Entomology Plate I. fig. 14. 15. the larva on Plate II. fig. 19. and the pupa at fig. 20 of the same plate.

THE LAPLAND GAD-FLY, *Æstrus tarandi*.

This species frequents the backs of rein-deer, especially those that are tamed, and deposits its eggs there; it is twice the size of the bovis, and called by the Laplanders *curbma*. The wings are without spots, and the body is covered with a yellowish down.

The

The ZIMB.

The formidable African fly, described by Mr. Bruce under the name of *zimb*, or *tsaltsalya*, may perhaps be referred to this genus; at least there are some particulars in its history which would lead one to suppose it an *Cæstrus*.

“ This insect (says Mr. Bruce) is a proof how fallacious it is to judge by appearances. If we consider its small size, its weakness, want of variety or beauty, nothing in the creation is more contemptible and insignificant. Yet, passing from these to his history, and to the account of his powers, we must confess the very great injustice we do him from want of consideration. We are obliged, with the greatest surprise, to acknowledge, that those huge animals, the elephant, the rhinoceros, the lion, and the tiger, inhabiting the same woods, are still vastly his inferiors, and that the appearance of this small insect, nay, his very sound, though he is not seen, occasions more trepidation, movement, and disorder, both in the human and brute creation, than would whole herds of these monstrous animals collected together, though their number were in a tenfold proportion greater than it really is.

“ This insect is called *zimb*; it has not been described by any naturalist. It is in size very little larger than a bee, and his wings, which are broader than those of a bee, placed separate, like those of a fly: they are of pure gauze, without colour or spot upon them; the head is large, the upper jaw or lip is sharp, and has at the end of it a strong pointed hair of about a quarter of an inch long; the lower jaw has two of these pointed hairs, and this pencil of hairs, when joined together, makes a resistance to the finger nearly equal to that of a strong hog's bristle. Its legs are serrated in the inside, and the whole covered with brown hair or down. As soon as this plague appears, and their buzzing is heard, all the cattle forsake their

food, and run wildly about the plain, till they die, worn out with fatigue, fright, and hunger. No remedy remains for the residents on such spots but to leave the *black earth*, and hasten down to the sands of Atbara, and there they remain while the rains last, this cruel enemy never daring to pursue them farther. Accordingly, all the inhabitants of the sea-coast of Melinda, down to Cape Gardesfan, to Saba, and the south of the Red Sea, are obliged to put themselves in motion and remove to the next sand in the beginning of the rainy season, to prevent all their stock of cattle from being destroyed. This is not a partial emigration; the inhabitants of all the countries from the mountains of Abyffinia northward, to the confluence of the Nile and Aftaboras, are once a-year obliged to change their abode, and seek protection in the sands of Beja; nor is there any alternative, or means of avoiding this, though a hostile band was in their way, capable of spoiling them of half their substance.

“Of all that have written upon these countries, the prophet Isaiah alone has given an account of this animal, and the manner of its operation. *And it shall come to pass in that day, that the Lord shall hiss for the fly that is in the uttermost part of the rivers of Egypt. And they shall come, and shall rest all of them in the desolate vallies, and in the holes of the rocks, and upon all thorns, and upon all bushes.* Isa. xvii. 18, 19.”—By the expression of *resting in the desolate vallies*, &c. Mr. Bruce understands the prophet to mean “that they shall cut off from the cattle their usual retreat to the desert, by taking possession of those places, and meeting them where ordinarily they never come, and which therefore are the refuge of the cattle.”

“Providence, (says Mr. Bruce,) from the beginning, it would seem, had fixed its habitation to one species of soil. It prohibited absolutely those inhabitants of the fat earth called *Mazaga*, domiciled in
caves

caves and mountains, from enjoying the help or labour of any beasts of carriage. It deprived them of their flesh and milk for food, and gave rise to another nation, whose manners were just the reverse of the first. These were the shepherds, leading a wandering life, and preserving these immense herds of cattle by conducting them into the sands beyond the limits of the black earth, and bringing them back again when the danger from the insect was over.

“ We cannot read the history of the plagues which God brought upon Pharaoh by the hands of Moses, without stopping a moment to consider a singularity, a very principal one, which attended this *plague of the fly*. It was not till this time, and by means of this insect, that God said he would separate his people from the Egyptians; and it would seem that then a law was given to them that fixed the limits of their habitation. It is well known, as I have repeatedly said, that the land of Goshen, or Geshen, the possession of the Israelites, was a land of pasture, which was not tilled or sown, because it was not overflowed by the Nile. But the land overflowed by the Nile was the *black earth* of the valley of Egypt, and it was here that God confined the flies; for he says it shall be a sign of this separation of the people, which he had then made, that not one fly should be seen in the sand or pasture ground, the land of Goshen; and this kind of soil has ever since been the refuge of all cattle emigrating from the *black earth* to the lower part of Atbara. Isaiah indeed says that the fly shall be in all the desert places, and consequently the sands; yet this was a particular dispensation of Providence to answer a special end, the desolation of Egypt; and was not a repeal of the general law, but a confirmation of it; it was an exception, for a particular purpose, and a limited time.”

Mr. Bruce adds that this insect has no sting, but that its motion is more rapid than that of the bee, and resembles that of the gad-fly in England; and that there is something particular in its sound or buzzing.

It

It is a jarring noise, together with a humming, which induces Mr. Bruce to suppose that it proceeds, at least in part, from a vibration made with the three hairs at the snout. He observes, farther, that the Chaldee version is content with calling this animal simply *ze-bub*, which signifies *the fly* in general, as we express it in English. The Arabs call it *zimb* in their translation. The Ethiopic translation calls it *tsalifalya*, which is the true name of this particular fly in Geez, and was the same in Hebrew.

TIPULA, THE CRANE-FLY

GENERIC characters, Mouth merely a prolongation of the head; proboscis short, and bent inwards, the upper jaw being arched; feelers two, incurvated, and longer than the head. The whole genus is readily distinguished by the enormous length of their legs, by which they are enabled to walk among the grass, as men are assisted by stilts in passing through marshy ground.

There are 135 species, in two divisions: the larger species, sometimes called sempstresses, have expanded wings; the smaller kinds, forming the second division, have the wings incumbent. These last, in fine summer evenings, flutter about the sides of rivers in legions. The shrill noise which they make with their wings is not very discernible unless they are very near: they are sometimes taken for gnats; but their manners are more inoffensive.

The tipulæ, before they become inhabitants of the air, creep in the form of grubs: those of the larger kinds dwell in holes of decayed willows, where they change into chrysalides. In that state, they have the power of breathing through small curved holes. The larvæ and chrysalides of the smaller tipulæ are generally found in water; they are extremely various both in colour and form: some have cylindrical tubes through which they breathe, even while considerably immersed

immersed in water, by stretching their points to the surface. They swim with great nimbleness, but seldom forsake the hole they have dug in the bank of the river. There are others of these animals that spin a silken coat, that receives part of their long body before their transformation. After these operations are performed, all of them renounce their reptile and aquatic life, having received instruments of flight from the hands of nature. Their frame is then so weak, that a touch is enough to crush them. They are sometimes of a beautiful green, sometimes coal black; but the most remarkable are those whose fore-legs, though extremely long, do not touch the ground, but move in the air like antennæ. In this their last and most perfect state, the tipulæ, being provided with proper organs, apply themselves to the important work of propagation; and, having provided for another generation, their short existence draws to a close.

The FATHER LONG-LEGS, *Tipula pectinicornis*.

SPECIFIC character, antennæ pectinate; wings expanded, with a black spot; abdomen rufous at the base, barred with yellow in the middle, and tipped with black.

Inhabits Europe: proceeding from a dusky or greyish larva of a lengthened form, and destitute of legs. It is found beneath the roots of grass in meadows, gardens, &c. and in the months of July and August changes into a lengthened and pointed chrysalis of a dusky colour, out of which in September proceeds the complete animal, and is frequently seen in houses during the autumnal evenings, when it is remarkable for the propensity, in common with many other insects, of flying towards the flame of candles, and in consequence often perishing in the blaze.

The SAFFRON CRANE-FLY *Tipula crocata*.

One of the few insects of this genus adorned with
lively

lively colours: it is of a polished black, with yellow rings round the abdomen.

The POT-HERB CRANE-FLY, *Tipula oleracea*.

A very common species, of nearly similar size with the preceding, and with transparent wings with a dusky rib or upper edge. Its larva inhabits garden-grounds, where it commits ravages among various plants. It may be added that the chrysalis, in most of the terrestrial insects of this tribe, is furnished at the upper part with a pair of short horn-like processes, perhaps operating as a kind of spiracula: this particularity is however still more striking in those which belong to the aquatic kinds.

The SPINING CRANE-FLY, *Tipula cornicina*.

Middle size, with transparent wings with a marginal dusky spot, and the body yellow with three longitudinal dusky streaks. Its larva, which is found in meadows, &c. is brown, with a flattened or truncated tail, beset with a certain number of radiating soft spines or processes. The chrysalis is slender, and furnished, as in most others, with minute spines about its segments, by the assistance of which it is enabled to elevate itself to the surface when the time of its ultimate change takes place.

The PLUMED CRANE-FLY, *Tipula plumosa*.

This insect is of the size of a gnat, which it so much resembles in its general appearance as to be frequently mistaken for one: its colour is a greenish brown. The larva is aquatic, bears a considerable resemblance to those of the genus *Culex*, as does likewise the chrysalis or pupa, which, instead of lying dormant during this state, is locomotive, playing about in the water, like the larva, and, at the time of its change, springs to the surface in order to give birth to the complete insect.

insect. This is the first of the division with incumbent wings.

The MOTH CRANE-FLY, *Tipula phalænoides*.

This minute fly is very frequently observed in great numbers on windows during the decline of summer, appearing principally in the evening. It has so little the appearance of a genuine *Tipula*, that it would hardly be considered as belonging to this genus by a common spectator. Its general length is about the tenth of an inch, and the wings, which are very large in proportion to the insect, are of an oval shape, and of a grey colour, elegantly mottled or variegated with dusky specks: the edges are deeply fringed with hair, and the nerves beset with oblong scales or feathers; and the whole insect, microscopically examined, exhibits a highly-elegant appearance.

DIOPSIS, the SPECTACLE-FLY.

GENERIC characters, Antennæ very small, setaceous; eyes situated on very long processes-like horns.

For the discovery of this genus we are indebted to Dr. Fothergill, who presented his friend Linnæus with a great number of insects that he had collected from South America and Guinea; among which, in arranging them, M. Dahl found this singular fly, of which he published an account in his *Dissertatio Entomologica*, 4to. Upsal, 1775. There never has been any other species discovered besides this one, which Linnæus named

The ICHNEUMON SPECTACLE-FLY, *Diopsis ichneumonea*.

It is about the size of the red-ant, and height of the common ichneumon-fly. It has one tooth in the mouth on each side; the head, which is of a reddish colour, is lengthened, and from which proceed two filiform horns, as long as the corselet; these horns are divergent, solid, inarticulate, and ferruginous;

and at the tops or ends of these are placed the eyes, which are spherical, inclined, and lucid black. Just below them, on the inner part of each horn is a tubercle, whence issues a kind of bristle, which seems to be the rudiment of an antenna. The corselet is black, armed with a single spine on each side, and terminated by two yellow subulated spines. It has a pair of transparent hyaline wings, with a black spot on the outer part of each, near the end. The body is reddish; legs yellow; belly like the ichneumon, club-shaped, somewhat pedicelled, the two last wings black; feet black; front thighs club-shaped. It was for some time difficult to decide in what order this singular insect should be placed. The style and club-shaped balancers under their scales at length determined Gmelin to place it among the diptera: yet the spines on the corselet distinguish it from all the genera of that order, and make it approach to the ants. Its long claws and club-shaped belly, and black spot towards the extremity of the wings, give it the air of an ichneumon; from which however it is clearly distinguished by the horns being immoveable, whereas those of the ichneumon are in continual motion; they are not jointed, are much longer than the head, cylindrical, and firmly fixed, and cannot therefore be regarded as antennæ. The eyes are very remarkably placed at the extremity of the horns, somewhat prominent, and therefore very far from the head. The antennæ are not discovered at first sight; but, by close attention, the tubercles above mentioned are seen near each eye, furnished with a bristle or hair; and these no doubt perform the office of antennæ.

MUSCA, THE FLY.

GENERIC characters, Mouth formed into a fleshy proboscis, with two lateral lips; palpi and antennæ very short, or none.

The vast extent of the genus *Musca*, including 511 species,

species, makes it necessary to divide the whole into different assortments, in order to the more ready investigation of the species. These divisions are instituted from the form of the antennæ, which are either simple, (without any lateral hair or plume;) or armed, (that is, furnished with a lateral hair or plume.) These divisions are farther separated into others, according to more or less downy or hairy appearance of the insects.

The larvæ in the different tribes of flies differ far more in habit than the complete insects; some being terrestrial, and others aquatic. Those of the more common kinds are emphatically distinguished by the title of *maggots*, and spring from eggs deposited on various putrid substances. Several of the aquatic kinds are of singularly curious formation, and exhibit wonderful examples of the provision ordained by Nature for the preservation of even the meanest and seemingly most contemptible of animals. Several are inhabitants of plants, feeding during this state on other living insects. The general form of the chrysalis or pupa is that of an oval, differently modified according to the species, and formed by the external skin of the larva, which hardens round the chrysalis. Some species however cast their skin before their change into the pupa state.

Nothing more clearly demonstrates the imperfection of the science of entomology than the small number of flies that have been hitherto described by naturalists. The System of Nature, in its last state of enlargement, was supposed to contain the most accurate and complete enumeration of insects that had yet been published: Mr. Harris, however, in his Exposition of the English Insects, describes a greater number of flies indigenous in this country, than the Swedish naturalist had discovered on the whole face of the globe. England is at the same time far from being the most productive country of these animals. In

Spain, they were formerly so numerous, that the fly-catcher, we are told, was not only a profession, but a number of men were commissioned by government to give chase to these troublesome invaders. In all hot climates they multiply to a degree almost intolerable, and are extremely destructive to butchers-meat, and other kinds of provision.

Next to the number of flies, their variety claims our attention. The different species are extremely diversified in their external form, their structure, their organization, their metamorphosis, their manner of propagating their species and in providing for their posterity. A full explanation of these different parts of their economy, would require a large volume, and would constitute a narrative to many readers not uninteresting. Such an undertaking, however, is incompatible with the limits prescribed to our work.

Some of these insects have trunks instead of a mouth; others have that organ armed with teeth; and many have both a mouth and a trunk. The proboscis of flies is a machine contrived for pumping the blood from the vessels of large animals, and the nectar from the petals of flowers; and the science of hydraulics has not enabled men to construct machines more complicated, more exactly arranged, or better adapted to these purposes. Some of them possess considerable firmness and solidity, those especially that are destined to pierce the skins of cattle. In order to see them at work, all that is necessary is to expose a syrup to attract them, and to take up a lens for their inspection.

Each eye of the fly contains in it an assemblage of a great number of small ones, which probably have the effect of multiplying the surrounding objects, and creating representations of them, which the experience of the insect corrects. From the eye if you pass along and survey the body, you find it provided with the organs of respiration. Four small stigmata, for
this

this purpose, are found upon the thorax, and a greater number dispersed over the annuli of the abdomen. The covering of the different parts of the abdomen are scaly, and do not consist all of one piece, but admit of the contraction and dilatation of that part, according to the circumstances of the animal. Each of the feet terminates in a small bunch of *setæ*, resembling a brush.

The interior organization of this genus, when examined with a proper apparatus, presents two pulmonary sacs of a white colour, arranged longitudinally along the body. As the bodies of some species are diaphanous, the action of the heart may also be discerned, as well as the liquor it contains, continually driven along the great artery leading to it, and returning by the same course.

The food of flies is as various as their different kinds; some being supported wholly by vegetable substances, while others are carnivorous; and among the latter there are some who only devour flesh in a state of putrefaction. Dung, and vegetables in a similar state, are the favourite meals of others. In the history of the *cæstrus*, we have already noticed that instinct by which the females are directed to deposit their eggs within reach of food proper for each species.

The female flies are all secundated by copulation; an act in which the most incurious observer must have frequently seen them engaged. The observations of Reaumur seem to prove, that the females of some kinds take that part in the act of secundation which is usually performed by the male in other animals; and that it is her extremity which penetrates into the body of the male. The far greater part of insects are oviparous; some, however, belonging to this genus bring forth living young; but what appears most unaccountable is, that some apparently of the same species are viviparous, while the rest lay eggs; a circumstance that shows the futility of our attempts to arrange

range them. Some of the viviparous flies possess a degree of fecundity that must appear altogether incredible to those who have not been versant in the study of insects. Some of them have been found to contain in their body no less than twenty thousand living animals at one time. Reaumur, tom. iv. Mem. 10.

The BLOW-FLY, *Musca vomitoria*.

This is called *M. carnaria* by Dr. Shaw, because, as every one knows, it deposits its eggs on animal flesh, either fresh or putrid. The larvæ or maggots hatch in about the space of a few hours, and when full grown, which happens in eight or ten days, are of a white or yellowish white colour with a slight tinge of pale red, and of a lengthened shape, with a sharpened front, in which the mouth is situated, and from whence the body gradually enlarges in size to the last or terminal segment, which is of a very broad and flattened form, surrounded by several slightly-prominent tips, and furnished with a pair of dusky specks resembling eyes; so that an inaccurate spectator might easily mistake this part for the head, and the proper head for the tail. When the animal changes to a chrysalis, the skin dries round it, and the whole assumes a completely oval form, and a reddish colour, soon changing into a reddish brown. In ten days more the fly itself emerges, which is too well known to require particular description.

To this has been applied the observation, *Tres muscæ consumunt cadaver equi æque cito ac leo*; "Three flies will destroy the carcase of a horse as quick as a lion." Signifying that the number of larvæ proceeding from the flies, and the quick evolution of the successive broods, destroy the same quantity of flesh in a given time as the predacious quadruped, who devours a great quantity at certain intervals only; while the process of destruction continues with unremitted perseverance

perseverance on the part of one or other of the respective races of the flies.

The LARGE HAIRY-FLY, *Musca grossa*.

This is the largest of all the European flies, being considerably larger than the largest blow-fly, and is of a black colour, with the wings dull orange-coloured at their base.

The YELLOW FLY, *Musca flava*.

This is one of the smallest but most elegant of the European flies, and is not very uncommon during the autumnal season, being observed in gardens and in windows. It is about the eighth part of an inch in length, and of a yellow colour with gold-green eyes.

The BLACK FLY, *Musca chamæleon*.

Abdomen broad and flattish, sides of each segment yellow, forming so many abrupt semi-bands across that part. It proceeds from an aquatic larva, of very considerable size, measuring two inches and half in length; of a somewhat flattened shape, and of a brown colour, with a narrow or slender front, the body widening by degrees towards the middle, and thence gradually tapering to the extremity or tail, which is terminated by a circle of radiating or diverging hairs. This larva is common in stagnant waters during the summer months, and passes into its chrysalis state without casting its skin, which dries over it, so as to preserve the former appearance of the animal in a more contracted state.

The WORM-CATCHER, *Musca vermileo*.

A middle-sized fly, of a somewhat lengthened form, with a distant resemblance to a Tipula. It is of a dull yellow colour, with transparent wings; the thorax marked above by two black lines, and the abdomen by a triple series of black spots. The larva of this

this species measures about three quarters of an inch in length, and is of a pale yellowish grey colour; slender or sharpened in front, and growing gradually broader towards the tail. It is found in the southern parts of Europe, and is not uncommon in some districts of France, and is remarkable for practising a method exactly similar to that of the *Hemerobius formicaleo* in order to obtain its prey; excavating a circular pit or cavity in the dry sand; concealing itself beneath the centre, and thus waiting the arrival of any small insect which may happen to fall into it, and, after absorbing its juices, throwing out the exhausted remains to a considerable distance from the verge of the cavity. This larva seems to have been first observed and described by Reaumur, in the Memoirs of the French Academy for the year 1752. It assumes the state of a chrysalis by casting its skin, which rolls to the hinder part of the body: the chrysalis is of a dull reddish colour, and is rounded or clubbed at the upper part, suddenly tapering from thence to the extremity, and, after lying nine or ten days, gives birth to the included insect.

The PENDULOUS FLY, *Musca pendula*.

A moderately-large and very beautiful insect. Its colour is black, with four bright yellow stripes down the thorax, and three broad interrupted bars across the abdomen; or, in other words, this fly might be described as of a bright yellow colour, with the thorax marked by four longitudinal black lines, and the abdomen by three transverse ones, connected by a black stripe down the middle. Its larva, which is an inhabitant of stagnant waters, is of a most remarkable appearance, being furnished with a tail of great length, composed of a double tube, the interior of which is very slender, extensile, at the pleasure of the animal, to a vast length, and terminated by a very small spiracle. The length of this tube is therefore
varied

varied according to the greater or smaller depth at which the insect chuses to continue; the tip reaching to the surface, in order to supply the requisite quantity of air. Sometimes great numbers of these maggots are found coiled or twisted together by their tails, in such a manner that it is by no means easy to separate any one from the rest. The complete insect is frequently seen on flowers during the autumnal season.

The HARDY FLY, *Musca tenax*.

About the size of a drone, and of a brown colour, with transparent wings, and the first segment of the abdomen yellowish on each side. It proceeds from a larva of a very singular appearance, being a long-tailed brown maggot, of rather slow motion, measuring about three quarters of an inch in length, exclusive of the tail, which is extensile, and consists of a double tube, the exterior annulated into numerous segments, and the interior slender, and terminated by a circle of hairs, surrounding a spiraculum or air-hole. This maggot is seen in muddy stagnant waters, drains, and other places of the dirtiest description; and, notwithstanding its unpleasing appearance, exhibits, when accurately examined, many particulars well worthy of admiration: the feet in particular, which are seven in number on each side, are wonderfully calculated for enabling the animal to ascend walls or other perpendicular places, in order to seek some proper situation in which it may undergo its change into chrysalis, being very broad, and beset on their under surface with numerous small hooked claws; giving it the power of clinging with security during its ascent.

Of this larva a particularity is stated, on the authority of Linnæus, which, if true, may indeed well be numbered among the *Miracula Insectorum*, (the title of the paper in the *Amœnitates Academicæ*, in which it is announced,) viz. that, being a frequent inhabitant

of the turbid pulp used in the operation of paper-making, it is often exposed to the action of the wooden mallets used in the process, as well as squeezed in the strongest presses; and yet survives uninjured these seemingly destructive operations! The above larva commonly changes to a chrysalis about the end of August; the skin contracting, and drying round the body, and the tail continuing in a shrivelled state. After thus remaining about the space of a fortnight, it gives birth to the complete insect, which has so much the general appearance of a drone, that it is very frequently mistaken for such. It is extremely common during the month of September.

TABANUS, THE HORSE-FLY, or FLOGG.

GENERIC characters, Mouth formed into a fleshy proboscis, terminated by two equal lips; sucker projecting, lying in a groove on the back of the proboscis; feelers two, pointed, on each side of, and parallel with, the proboscis.

In general appearance or habit these insects bear an extreme resemblance to those of the preceding genus. They are the great tormentors of horses and black cattle. Cattle, either when intended for fattening or for milk, are greatly harrassed and injured by these insects in the hot months; and whoever could prevent their mischief, could certainly be entitled to those honours and rewards that are due to the discoveries of useful improvements in rural economy. There are 52 species.

The Ox-FLY, *Tabanus bovinus*.

In this species the head is grey; but the eyes, which occupy the greater part of it, are green. It is marked down the back by a series of large whitish triangular spots, pointing downwards: on each side also is an approach to a similar appearance, though less distinct than that of the dorsal row. This insect, like the rest

rest of its genus, is seen during the middle and the decline of summer; generally in the hottest part of the day. It is often near an inch in length; proceeding from a large dusky-yellowish larva, nearly resembling that of a *Tipula*, and marked by transverse blackish streaks or rings: it resides under ground in moist meadows, &c. and changes to a cylindric brownish chrysalis, with a roundish or very slightly pointed extremity; out of which, in the space of a month, proceeds the perfect insect.

The RAIN-FLY, *Tabanus pluvialis*.

Size of a window-fly, but longer in proportion. It is of a dull brown colour, with the wings of a similar cast, but marbled or variegated with very numerous whitish specks: this is a very troublesome insect during the latter part of summer, fastening on the legs, hands, &c. and causing considerable pain by the puncture of its proboscis: it is observed to be peculiarly teazing on the approach of rain.

CULEX, THE GNAT.

THE gnat is named *culex ab aculeo*, from its sting. The generic character is, Mouth formed by a flexible sheath, inclosing bristles pointed like stings. The antennæ of the males are filiform; those of the females feathered. There are fourteen species.

These insects, so well known by the severe punctures they inflict, and the itchings thence arising, afford a most interesting history. Before they turn to flying insects, they have been in some manner fishes, under two different forms. "You may observe, (says Barbut,) in stagnate waters, from the beginning of May till winter, small grubs with their heads downwards, their hinder-part on the surface of the water; from which part arises sideways a kind of vent-hole, or small hollow tube, like a funnel, and this is the organ of respiration. The head is armed with hooks,

that serve to seize on insects, and bits of grass on which it feeds. On the sides are placed four small fins, by the help of which the insect swims about, and dives to the bottom. These larvæ retain their form during a fortnight or three weeks, after which period they turn to chrysalides. All the parts of the winged insect are distinguishable through the outward robe that shrouds them. The chrysalides are rolled up into spirals. The situation and shape of the windpipe is then altered; it consists of two tubes near the head, which occupy the place of the stigmata, through which the winged insect is to breathe. These chrysalides, constantly on the surface of the water in order to draw breath, abstain now from eating; but upon the least motion are seen to unroll themselves, and plunge to the bottom, by means of little paddles situated at their hinder part. After three or four days strict fasting, they pass to the state of gnats. A moment before, water was its element; but now, become an aerial insect, he can no longer exist in it. He swells his head, and bursts his inclosure. The robe it lately wore turns to a ship, of which the insect is the mast and sail. If at the instant the gnat displays his wings there arises a breeze, it proves to him a dreadful hurricane; the water gets into the ship, and the insect, who is not yet loosened from it, sinks and is lost. But in calm weather the gnat forsakes his slough, dries himself, flies into the air, seeks to pump the alimentary juice of leaves, or the blood of men and beasts. The sting which our naked eye discovers is but a tube containing five or six spicula of exquisite minuteness, some dentated at their extremity like the barb of an arrow, others sharp-edged like razors. These spicula, introduced into the veins, act as pump-suckers, into which the blood ascends by reason of the smallness of the capillary tubes. The insect injects a small quantity of liquor into the wound, by which the blood becomes more fluid, and is seen under the microscope

microscope passing through those spicula. The animal swells, grows red, and does not quit its hold till it has gorged itself. The liquor it has injected causes by its fermenting that disagreeable itching which we experience, and which may be removed by volatile alkali, or by washing with cold water. Gnats perform their copulation in the air. The female deposits her eggs in the water, by the help of her moveable hinder-part and her legs, placing them one by the side of another in the form of a little boat. This vessel, composed of two or three hundred eggs, swims on the water for two or three days, after which they are hatched. If a storm arises, the boats are sunk. Every month there is a fresh progeny of these insects. Were they not devoured by swallows, and by several carnivorous insects, the air would be darkened by them."

The COMMON GNAT, *Culex pipiens*.

Specific character, colour cinereous, with eight brown rings on the abdomen. Inhabits Europe, and is well known, almost every where, by its shrill buzzing noise and severe puncture.

That formidable insect called the *musquito*, so much dreaded by the inhabitants of the West-Indies and America, where its bite seems to operate with peculiar malignity, is supposed to be no other than a variety of the common European gnat, which derives additional vigour from the warmer and moister atmosphere of the regions of the western hemisphere. In those countries, both in the day-time and at night, they come into the houses, and, when people are gone to bed, they begin their disagreeable humming, approach always nearer to the bed, and at last suck up so much blood that they can hardly fly away. Their bite, like that of bugs, causes blisters in people of a delicate complexion. When the weather has been cool for some days, the musquitoes disappear; but when it changes

changes again, and especially after rain, they gather frequently in such quantities about the houses, that their number is astonishing. In sultry evenings they accompany the cattle in great swarms, from the woods to the town; and, when they are driven before the houses, the gnats fly in wherever they can. In the greatest heat of summer, they are so numerous, in some places, that the air seems to be quite full of them, especially near swamps and stagnate waters, such as the river Morris in New Jersey. The inhabitants therefore make a fire before their houses to expel these disagreeable visitors by the smoke; and at night have nets of gauze hung round their beds.

The CREEPING GNAT, *Culex reptans*.

Specific character, black with hyaline wings, a white ring on each leg. This is the same with the *gnat of the Bannat*, first described by Brunnich, and which had then been observed only in the Bannat of Temeswar in Europe. It is at length ascertained by Pallas, after much investigation, to be also the same insect as the Russian *moschara*, or stinging gnat. His account, very lately published, is as follows: "My doubts on this subject induced me to apply to Baron von Born, to whose information I had often been before indebted; and by his means I obtained a small collection of real Columbach gnats, among which I distinguished, on the first view, the Russian *moschar*, of a considerable size, and even an insect which I had so often wished to procure when collecting plants and insects in the Altai mountains, and on the Volga. They are small flies, as thick but much shorter than the common gnats, and which, according to their characteristic marks and form, have a greater resemblance to the *bibiones* of Geoffroy than to gnats. (They had been hitherto called by Pallas *bibio sanguinarius*.) Their breast, which is strong, projects in a round form; the head is flat, and at the top ends in a sharp

a sharp oblique edge, has at the sides oblong eyes, and below tapers to a proboscis, which ends in two sharp points; the feelers are of a brownish yellow colour, thick, and sharp pointed, placed near each other on the forehead; the legs are much shorter than those of the gnat; the thighs and part next the joints of the legs are all white, and only blackish towards the ends; in some the thighs towards the body were whitish; the extremity of the body, which appears very dry and contracted, is surrounded with rings of brown, but the breast appears black shaded with grey; the wings, which are pretty large and broad, appear whitish, with their veins, and lie over each other. Such I found the Columbach gnat; and I have seen the Siberian moschара, or that common in the neighbourhood of the Volga, perfectly similar, only that it was somewhat smaller, and had not so broad white rings on the legs. I entertain no doubt, therefore, that they are both of the same species. I am also convinced that the *Culex reptans* of Linnæus is nothing else than the same insect which is found in the northern countries, somewhat smaller and not in such abundance. Linnæus found great multitudes of the latter in the mountainous districts of Lapland, whereas in Sweden they are more uncommon. According to his observations, they attack people principally towards sun-set, crawl over their whole bodies, even into the mouth, nose, and eyes, and cannot be driven away like other gnats, by shaking or blowing. If his description in the *Fauna Suecica* be compared with ours, it will be found very little different. These troublesome flies are found here and there in the northern forests of Russia, but singly, and for the most part they run about among the hair of the cattle. But on the Volga, below Kasan, where that river begins to flow between woody mountains, and approaches a warmer district, particularly from the neighbourhood of Simbirsk to Saratof and Kamychenka,

chenka, they are met with from the end of May to the beginning of June in such astonishing multitudes, in low bushy places, and the woody hills sheltered from the wind, that they seem to fill the atmosphere like hail, falling blindly and with violence against the face, which is affected as if sand were thrown against it; they fly into the eyes, nose, and mouth, adhere pertinaciously to the skin, and with their blunt trunks pierce it often in such a manner as to occasion pain, so that a bloody puncture remains, though without itching. Fishermen, hunters, and all those who, by their employments, are exposed to the open air, or who travel, furnish themselves about the above period with a large-net cap, soaked in birch oil, because it has been observed that the *moscaræ*, however blindly they rush against every thing, never venture to fly against those open nets which have been soaked in the above strong-smelling oil. Without these means it would be often impossible to open the eyes. When the insect has an opportunity of fastening itself on the skin unperceived, and of sucking the blood, it fills its belly till it appears like a blown-up bladder, and cannot be removed but by killing it. As people cannot open their mouth without several of them getting into it at once, it often happens that they bite or squeeze them between the teeth; and one then feels, without wishing it, that the entrails have a sweet mellicious taste. At the end of June, they almost all disappear, and are not again seen till August; but at that period they are far less abundant. These flies are equally numerous in the Ural mountains, but they are still more so in the neighbourhood of the woody mountains of the southern part of Siberia beyond the lake Baikal. In the month of June, people are tormented with these vermin even on the mountains, till they reach the cold summits, where there are no woods. In the latter end of summer, however, they are not to be seen in those districts. Travelling

velling from Jakusk to Ochozk, they are to be again found in immense multitudes as soon as one has passed the Aldaan, and perhaps they are to be found also in North America.

It is commonly reported, in the Siberian and Ural mountains, that these small insects, with the assistance of the gad-flies, which abound about the same period, torment horses, and other cattle, in such a manner as to occasion their death when they run about in the forests, and have no opportunity of escaping to the open country, or to a fire, the smoke of which would drive them away. Instances of this, however, are not so frequent in these countries as, according to every account, they must be in the Bannat of Temeswar. The cause of this, perhaps, is to be ascribed to the great size of these gnats in the latter country, and perhaps also to some poisonous quality connected with their sting; for I have observed, even in Siberia, that their sting sometimes occasioned on the human body large tumours, which scarcely disappeared at the end of forty-eight hours."

What Griselini has related of these insects we should have considered as containing too much of the marvellous, had not Baron Born, in his Letters, confirmed the accounts of the destructive nature of these vermin in that country: "They come to the Bannat of Temeswar (says he) by millions, as soon as the bloom appears on the trees in the spring; fall upon the cattle, creep through the rectum, the nostrils, and the ears, into the most interior parts of their bodies, and kill them in four or five hours. When the animal is opened, they are found adhering in swarms to the lungs and to the bowels, which are completely inflamed. They continue three or four weeks, and are followed by immense clouds of dragon-flies, which devour every thing, and are in their turn devoured by the swallows, which find them in swarms. About

the end of July, or the beginning of August, the second brood appears, and accompanied with the like circumstances."

EMPIS, THE EMPIS.

GENERIC characters, Mouth with an inflected sucker and proboscis: sucker with a single-valved sheath, and three bristles: feelers short and filiform: antennæ setaceous. There are twenty-nine species of this insect now known, most of them very minute, which live by sucking out the blood and juices of larger animals. Five of the species are found in England; the largest of which is

The LIVID EMPIS, *Empis livida*.

Frequent in gardens upon plants and flowers; the head is small, of a roundish form; the thorax gibbous, of a pale green colour, with three longitudinal lines or bands. The eyes are of a reddish brown; the upper part of the abdomen of a dusky dun colour; the feet are long, hairy, and of a paler brown; the wings are incumbent, rather long, with dun-coloured veins. Degeer informs us, that in the year 1773 vast numbers of this species were observed on the ears of rye in some parts of Sweden, and were believed by the people to have considerably injured the crops; but this he considers as an unfounded notion, as they principally feed on flies, &c.

STOMOXYS, THE STOMOXYS.

GENERIC characters, Sucker with a single-valved sheath, inclosing from two to five bristles, each in its proper sheath; feelers two, short, setaceous, and articulated; antennæ setaceous. The species of this genus are 16, in two divisions, those with two bristles to the sheath of the sucker, and those with five. We shall give a specimen of each kind.

The

The PRICKING STOMOXYS, *St. irritans*.

Bristles two; colour cinereous, abdomen spotted with black. Inhabits Europe, and is very troublesome on the backs of cattle.

The BEAKED STOMOXYS, *St. rostratus*.

Bristles five, the sheath covering the mouth. This resembles the common fly, and is very troublesome to cattle. Wings pale; obscure lines on the thorax; proboscis, abdomen, and legs, testaceous.

CONOPS, THE CONIC-FACED FLY.

LIKE several of the preceding genera, the Conops subsists by sucking the juices of horses and cattle. During the autumnal season, it is very troublesome both to men and cattle, causing a sharp or pungent pain by the insertion of its proboscis, while in the act of sucking blood. It is, according to Linnæus, the principal cause of the wincing and kicking motion so frequent in horses during the heat of the day. Like the Tabani and some other flies, it is most troublesome on the approach of rain. But Linnæus very strangely remarks, that the uneasiness it gives to cattle while feeding, "is beneficial to them, by inducing a continual motion, and thus preventing them from perishing by indolence and repletion!!!"

The word Conops is derived from *κωνος*, a cone, and *ψ*, the face. The generic characters are, Rostrum porrected, and jointed like a knee; antennæ terminated by a flat and solid articulation, resembling the bowl of a spoon, with a lateral bristle, which, when closely examined, appears to be very hairy. There are twenty-two species of this insect now ascertained; three of them are natives of Asia; two are found in America; and the residue inhabit the different countries of Europe. A few of the species are found in England, which are troublesome to horses

and cattle, by stinging severely, and sucking their blood.

The LONG-HEADED CONOPS, *Conops macrocephala*.

This species is the most common with us, and might at first sight be taken for a species of wasp. It is smooth; the fore part of the head is lemon-colour, as are the poisers, the feet are dun-coloured. The thorax is variegated with black and reddish dun; the same takes place with respect to the segments of the abdomen; some of which are edged with lemon-colour, chiefly the second, and part of the third, towards the sides. The wings are brown, watered, and clouded. This beautiful conops, with some others differently marked, are seen buzzing in autumn, among the cattle in meadows.

ASILUS, THE HORNET-FLY.

MANY species of this genus glow with the most brilliant tints of green, purple, yellow, and brown. The generic characters are, A horny rostrum, projected, straight, and bivalved; body oblong, conic. These animals are generally found in swampy meadow-ground, where they prove very troublesome to cattle. They are provided with a sting, which inflicts a very painful wound. The proboscis, though sharp enough to penetrate the thickest skin, is nevertheless perforated, and supplies the place of a pump, in sucking out the blood of animals. There are 72 species.

The FERRUGINOUS ASILUS, *A. crabroniformis*.

Thorax gibbous; abdomen oval, slender, and tapering; the three first segments of the abdomen are black, the rest yellow; the feet and wings are of an iron colour. The graziers imagine, and perhaps with justice, that of all the insect tribe, this is the most noxious to black cattle; the very noise of their wings set them a-running; and, before they stop, they generally

OF DIPTEROUS INSECTS. 421

generally make their escape into a river, if any is near. On the other hand, Dr. Shaw observes, that, "though of a somewhat formidable aspect, this insect is incapable of piercing with any degree of severity: it preys on the smaller kind of insects." It proceeds from a smooth, yellowish-white, subterraneous larva, of a lengthened shape, and destitute of legs: the pupa resembles that of a Tipula.

The GIBBOUS ASILUS, *Asilus gibbosus*.

A larger species, nearly equalling a hornet in thickness as well as in length, and entirely of a deep-black colour, with the three terminal segments of the abdomen white: the whole is accompanied by a silken lustre as in the preceding species; the front of the head is of a greyish cast. This species is a native of the northern parts of Europe, and occurs in Lapland.

The FORK-TAILED ASILUS, *Asilus forcipatus*.

Considerably smaller than the preceding, and of a blackish brown colour, with the sides of the abdomen yellowish: the tail of the male is forcipated; that of the female simple.

BOMBILIUS, THE BUZZ-FLY.

GENERIC characters, Mouth with a very long straight setaceous sucker, formed of two unequal horizontal valves, containing setaceous stings. There are 48 species: they have an appearance somewhat resembling that of the smaller kinds of humble-bees, being thickly covered with erect downy hair: their flight is rapid, and they may be frequently observed, in the month of April, hovering about the garden-flowers, generally in damp situations. Even when in the act of sipping the nectareous dew from plants, they do not settle, but keep constantly buzzing upon the wing. They have no sting, and may be handled
with

with impunity. From their buzzing noise they derive their generic name.

The COMMON BUZZ-FLY, *Bombylius medius*.

This species is often seen, in the early part of spring, in gardens and fields, and is readily distinguished by its downy bee-like body, and its stait sharp-pointed proboscis, black and slender, sometimes divided into two at the extremity, which extends nearly three-fourths of the animal's length: the legs are of the same colour, slender, and long in proportion to the size of the insect. The body is short and truncated; the ground-colour black, but covered externally with dun-coloured tufty brown; the wings are unusually long, dark, and dotted with brown.

HIPPOBOSCA, THE HORSE-LEACH.

GENERIC characters, Mouth with a short cylindrical straight two-valved sucker; body depressed; feet armed with claws, by means of which they adhere to cattle and horses, in spite of every effort to rub them off. They abound in New Forest, Hampshire, and render it a very uneasy pasture for cows. The horse-leech is covered with a crustaceous shell, which renders it difficult to be killed, and gives it the air of some species of the bugs.

The COMMON HORSE-LEACH, *H. equina*.

Specific character, four claws on each foot, wings obtuse, thorax variegated. This species varies in size in different districts, and seems to be largest in the southern climates. It usually, however, measures something more than a quarter of an inch in length, and is of a flattened form, with a rounded abdomen, and moderately broad obtuse wings: its colour is a blackish chesnut, with the thorax speckled with white, and the abdomen marked with obscure variegations of a deeper cast. The skin is of a remarkably strong
or

or coriaceous nature, since the insect may be pressed strongly between the fingers without being apparently injured. The female of this insect deposits a single egg at distant intervals, and so very large is the egg, as at least to equal, if not in some degree to surpass, the size of the abdomen itself of the parent insect. In reality, however, this seeming egg may be rather considered as a pupa, since it undergoes no farther alteration of form: the figure of this precocious pupa is that of an oval, with an excavated depression at the lower end: its colour, at its first exclusion, is milk-white, except a large black spot on the part just mentioned. It continues perfectly inert, and gradually becomes of a brown, and at length, of a polished black colour, and thus commences a genuine or confirmed pupa, which, if opened after a certain period, exhibits the fly in its unadvanced state, and of a white colour. It often lies during the whole winter in this state; the fly emerging in the succeeding summer.

The SWALLOW-LEACH, *H. hirundinis*.

Six claws on each foot, wings tapering to a point. Much smaller than the preceding; and of a livid greenish colour, with the abdomen deeply emarginated behind, so as to represent the usual figure of an inverted heart: the wings are of a sharpened or lanceolate form; and the feet, instead of being terminated by two claws only, as in the generality of insects, have six sharp, curved, divisions; and, though four of these may rather be considered as a kind of spurious claws, yet they still operate as so many real unguiculi, and enable it to adhere with great tenacity. This species is very often observed on the bodies of swallows, swifts, and martins; and may almost always be found in their nests. Its motion, like that of the preceding kind, is brisk but irregular, moving in all directions with equal facility.

The

The SHEEP-TICK, *Hippobosca ovina*.

Very frequently found imbedded in the wool of sheep. It is of a reddish-brown colour, and differs from the rest of the genus in being entirely destitute of wings. Its pupa is also of a reddish-brown colour, exactly oval, and of a shining surface. All the *Hippoboscæ* are remarkably tenacious of life, and this in particular, which may often be observed in wool that has long been packed into fleeces.—There are two more species only.

ORDER VII. APTEROUS INSECTS.

A MULTIFARIOUS group of animals are comprehended under this order, which are all characterised by the privation of wings in both sexes. All the varieties of crabs and lobsters are introduced by Linnæus into this class of the animal kingdom; and that with great propriety, because they possess the antennæ, those organs which are peculiarly characteristic of the insect tribes. This order contains fifteen genera.

LEPISMA, THE LEPISMA.

THE insects of this genus are distinguished by possessing six feet formed for running; a mouth furnished with four palpi; two of which are setaceous, and two capitated. The body is covered with imbricated scales; and the tail is terminated by three bristly appendages; antennæ setaceous. The residence of the lepisma is commonly in gardens and damp houses. In the former, they retreat under mouldy boards or flag-stones; and in the latter, they are seen about window-sashes, and old boxes that have remained for some time in a humid situation. When their haunts are disturbed, they make off with such velocity, that they are seldom caught; and, when that happens, they are often destroyed, being, from their softness, easily crushed. There are only 7 species.

The

The WOOD-FISH, *Lepisma saccharinum*.

This is called a *fish* from its peculiar colour and tapering form. It is an insect of great elegance. Its general length, exclusive of the caudal bristles, is about half an inch, and its colour a bright silvery grey resembling that of pearls: this colour is owing to a covering of extremely minute oval scales, which are semi-transparent, and very easily detached from the animal by a slight touch: the head and thorax together form a rounded outline, the remainder of the body gradually lessening to the tail, which terminates in three long bristles, of similar appearance with the antennæ. The motions of this animal are remarkably quick, and it is often observed among various domestic articles, particularly sugar. It also occurs not unfrequently among old books and papers, which it is supposed often to injure. It is said to be originally an American animal, and to have been imported into Europe among sugars, &c. Dr. Browne, in his History of Jamaica, represents it as "extremely destructive to books and all manner of woollen clothes." But Dr. Shaw observes, that though this insect may occasionally injure books and papers, yet it is certain that the principal ravages committed on those articles are owing to insects of the genera of *Dermestes* and *Ptinus*, and particularly to the *Ptinus pectinicornis*, which, in the course of a few days, during very hot weather, and in places where it happens to abound, will nearly destroy a book by innumerable perforations.

The JUMPING LEPISMA, *L. polypodus*.

Of a dusky or brownish cast; and is found about the sea coast of many northern regions, under stones, &c. By means of the springs under its tail, it takes prodigious leaps, thus approaching the nature of the next genus.—There is a variety with five bristles in the tail.

PODURA, THE SPRING-TAIL.

GENERIC characters, Lip bifid; legs six, formed for running; eyes two, composed of eight facets; tail forked, formed for leaping, inflected. Antennæ filiform; feelers four, subclavate. There are 31 species; they are small insects, and in general are found in damp places, under stones, on the bark of trees, &c. When disturbed, they suddenly spring to a small distance by the help of a long forked process, which is doubled under the abdomen, and which is suddenly thrown out during the act of leaping. They feed on the leaves of various plants.

The ROUGH SPRING-TAIL, *Podura villosa*.

This is a British insect, and the largest of the tribe known to us. The ground colour is dark-brown, mixed with a shade of yellow, and variegated all over with streaks of black. The abdomen of this insect alone is smooth, the head being very much covered with hairs, which are so deciduous, that they stick to the fingers on handling the animal; the antennæ consist of four articulations, and are nearly as long as the body. This insect is generally found under stones.

The AQUATIC SPRING-TAIL, *P. aquatica*.

A common species. It measures scarcely the twelfth part of an inch in length; and is entirely of a black colour. It is gregarious, and is occasionally seen assembled in vast numbers, particularly near the brinks of ponds, covering the ground to the distance of several feet, and sometimes even the surface of the water itself. On the ground its legions, on a cursory view, have the appearance of scattered grains of gunpowder; and, if closely examined, will be found in an almost continual skipping motion.

TERMES, THE WHITE ANT.

GENERIC characters, Legs six, formed for running;

those of most other insects, into innumerable hexagonal convexities; the antennæ long and setaceous; the palpi or feelers two in number, of moderate length, and terminated in a large club-shaped tip; the thorax rather narrow, and the abdomen obtusely oval; the thighs or first joints of the legs thick, the remaining ones slender, and the feet furnished with very small claws; the whole animal is beset with small scattered hairs. According to the observations of the celebrated Derham, this insect, at its first hatching from the egg, which is white, oval, and extremely small, bears a complete resemblance to a common mite, being furnished with eight legs, and beset with long hairs. After a certain time it casts its skin, and appears in the very different form above described. Degeer observes that in some specimens he has remarked appearances similar to the rudiments of wings on each side the thorax, and resembling a pair of oblong scales. It is in the beginning of July that this change takes place, and at this time several may be seen with the wings half-grown: in a few days they seem to obtain their full size.

Mr. Derham imagines the ticking sound which these animals produce, to be analogous to the call of birds to their mates during the breeding-season; and there seems to be no reason for calling in question the truth of this observation. We may add, that this sound, as well as that produced by the *Ptinus fatidicus*, or death-watch, seems to afford a convincing proof of the faculty of hearing in insects, which some naturalists have been inclined to deny.

PEDICULUS, THE LOUSE.

GENERIC characters, Eyes two; legs six, formed for running; mouth furnished with an exsertile piercer, but no proboscis; antennæ the length of the thorax; feelers none; abdomen depressed, sublobated. There are 66 species, some of which infest the bodies of quadrupeds, others of birds, and some even those of insects

insects themselves. It must however be here observed, that many small insects, infesting other animals, have been often referred to the genus *Pediculus*, which in reality belong to those of *Acarus*, *Monoculus*, &c. &c.

The COMMON LOUSE, *Pediculus humanus*.

This nauseous insect is so well known as to render any very particular description unnecessary. As a species, it is distinguished by its pale livid colour, and lobated oval abdomen, with five joints to the antennæ. It is produced from a small oval egg, popularly called by the name of a *nit*, which is fastened or agglutinated by its smaller end to the hair on which it is deposited. From this egg proceeds the insect, complete in all its parts, and differing only from the parent animal in its smaller size. Such diminutive specimens are far preferable, for microscopic observation, to the full-grown insects, showing in a more distinct manner the disposition of the viscera, muscles, &c. &c. When thus examined by the microscope, the principal appearances are as follow: viz. The trunk or proboscis, which is generally concealed in its sheath or tube, is of a very sharp form, and is furnished, towards its upper part, with a few reversed aculei, or prickles: the eyes are large, smooth, and black: the stomach and intestines, which possess the greater part of the abdominal cavity, afford an extremely distinct and curious view of the peristaltic motion; while the ramifications of the trachæa, or respiratory tubes, appear dispersed in an elegant manner throughout various parts of the animal, and are particularly observable towards their orifices on the sides of the abdomen: the legs are each terminated by a double claw, not greatly unlike that of a lobster, but of a much sharper form; and the whole animal is everywhere covered by a strong granulated skin.

It is affirmed by Leeuwenhoek that the male is furnished

nished at the extremity of the abdomen with a sting; and that it is this instrument which causes the chief irritation suffered from these animals; the action of the tucker hardly seeming to have caused any perceptible pain on the skin of his hand. The male is readily distinguished from the female by having the tail or tip of the abdomen rounded: in the female it is forked or bifid. The same accurate observer (Leeuwenhoek), being desirous of learning the proportion and time of the increase of these insects, placed two lice in a black silk stocking, which he continued to wear day and night. He found that in six days one of them had laid fifty eggs, and upon dissecting it, he found as many more in the ovary: he therefore concluded that in twelve days it would have laid an hundred eggs: these eggs, hatching in six days, which he found to be their natural time, would probably produce fifty males, and as many females; and these females, coming to their full growth in eighteen days, might each of them be supposed, after twelve days more, to lay also an hundred eggs; which in six days farther, (the time required to hatch them,) might produce a younger brood of five thousand; so that in eight weeks a louse might see five thousand of its own descendants!

Of this insect there are two varieties; the one inhabiting the head, the other the body. No medical inquiries have yet found out why some families of the same tribe choose these different abodes. Infants and children are most infested with the former of these kinds; and sailors, soldiers, and old men, are most liable to be troubled with the latter. Cleanliness is the best antidote against these intruders; and their society seems a very proper punishment inflicted by nature on its neglect. The *phthriasis*, or lousy disease, though very little known in latter times, was not unfrequent among the ancients. Herod, Antiochus, Callisthenes, and Sylla, with many others, died of it.

It

It is uncertain whether this is to be ascribed to their inattention to cleanliness, their scarcity of linen, or their ignorance of the use of mercury. However this may be, there have been a few instances of this deplorable disease in our own country, and it is said that a nobleman of high rank is thus afflicted at this time. But such things are generally concealed from the public. The quantity of mercury necessary to cure the disorder would probably destroy the patient,

The CRAB-LOUSE, *Pediculus pubis*.

Abdomen emarginate behind; legs cheliform; antennæ of five articulations. Differs very little in appearance from the preceding. It infests the private parts, and sometimes the eyebrows; but never the head or body.

PULEX, THE FLEA.

THIS genus consists of only two species, which are characterised by six feet formed for leaping; filiform antennæ; a rostrum bent inwards, setaceous, and concealing a sting. The abdomen is laterally compressed and covered with imbricated laminæ; feelers none; eyes two. This tribe, like the preceding, is blood-thirsty, and fattens at the expence of the human race. It is said to prefer the more delicate skin of women; but feeds neither upon epileptic persons, upon the dead, nor the dying. Other animals as well as man suffer by its intrusions. It nestles in the fur of dogs, cats, and rats; and the nests of the river-swallow swarm with them.

The COMMON FLEA, *Pulex irritans*.

Specific character, proboscis shorter than the body. The body is of a dark brown colour, and of an oval form; it is apterous, and walks but little; but by the elasticity of its legs, can spring above two hundred times the length of its own body. From microscopic observations

observations which have been made upon this animal, it has been found to be oviparous. The female flea deposits or rather drops her eggs, at distant intervals, in any favourable situation: they are very small, of an oval shape, of a white colour, and a polished surface. From these, in the space of six days, are hatched the larvæ, which are destitute of feet, of a lengthened, worm-like, shape, and beset with distant hairs, and furnished at the head with a pair of short antennæ or tentacula, and at the tail with a pair of slightly-curved forks or holders: their colour is white, with a reddish cast, and their motions quick and tortuous. These larvæ are very frequently found in the nests of various birds, and, in particular of pigeons, where they fasten occasionally to the young brood, and saturate themselves with blood. In the space of ten or twelve days they arrive at their full growth, when they usually measure near a quarter of an inch in length: at this period they cease to feed, and, casting their skin, change into the state of a chrysalis, which is of a white colour, and of an oval shape, with a slightly-pointed extremity, and exhibits the immature limbs of the included insect. The larvæ are said to spin themselves up in an oval cotton-like covering before they undergo their change; this however is not always the case. After lying for the space of twelve days in chrysalis, the complete insect emerges in its perfect form. It now begins to exert its lively motions, and employs the sharp proboscis with which Nature has furnished it in order to obtain nourishment from the first bird or quadruped to which it can gain access. The time required for the evolution of this animal varies considerably according to the season of the year, and in the winter months is of much longer duration than the period above mentioned; the egg scarcely hatching under twelve days, and the larvæ lying nearly twice the usual time in chrysalis.

The

The history of this familiar insect does not appear to have been fully understood till towards the decline of the sixteenth century, when the observations of Leeuwenhoek and others were directed to it. It is believed, however, that the first person who investigated all the changes of the animal, from the egg to the perfect flea, was Signior Diacinto Cestone, an Italian, who communicated the account to the Royal Society of London. This was published in the 149th Number of the Philosophical Transactions, accompanied by figures, which though not conducted with the extreme accuracy which distinguishes the engravings of Roësel and some others are yet sufficient to give a pretty clear idea of the egg, larva, &c.

Among the chief singularities observable in the structure of the flea may be noticed the extraordinary situation of the first pair of legs, which instead of being placed beneath the thorax, as in most other insects, are situated immediately beneath the head. The antennæ are short, hairy, and consist of five joints; and at a small distance beneath these is placed the proboscis, which is strong, sharp-pointed, tubular, and placed between a pair of jointed guards or sheaths, which are still farther strengthened at the base, by a pair of pointed scales: the eyes are large, round, and black. The general appearance of the animal is too well known to require particular description: it may only be necessary to observe, that the male is considerably smaller than the female, with the back rather sinking than convex, as it always is in the female.

Preparations of mercury are effectual in destroying the flea, and most other noxious vermin. In some places, bugs, fleas, and other abominable insects, are held in superstitious veneration. At Surat, there is an hospital endowed for their preservation; where every night they prevail upon some poor wretch to suffer himself to be preyed upon for their sustenance: they fasten him naked upon a bed, where he is de-

prived of the means of self defence; and the famished pensioners riot in his blood during the whole night. — Another pious foundation of a similar nature, but less ludicrous, is erected in Turkey, for decayed or infirm dogs.

The CHIGGER, *Pulex penetrans*.

Specific character, proboscis as long as the body. The chigger, or chigoe, is a native of South-America and the West India islands. According to Catesby's microscopic figure of this insect, it may properly be arranged under the present genus; but it is probable, from the different descriptions of authors, that some insects of the genus *Acarus*, which excite similar swellings under the skin, have been confounded with it. Catesby's account runs as follows. "It is a very small flea, found only in warm climates: it is a very troublesome insect, especially to negroes, and others that go barefoot and are slovenly. They penetrate the skin, under which they lay a bunch or bag of eggs, which swells to the bigness of a small pea or tare, and give great pain till taken out; to perform which great care is required, for fear of breaking the bag, which endangers a mortification, and the loss of a leg, and sometimes life itself. This insect, in its natural size, is not above a fourth part so big as the common flea. From the mouth issues a hollow tube like that of the common flea, between a pair of antennæ. It has six jointed legs, and something resembling a tail. The egg is so small as to be scarcely discerned by the naked eye. These chigoes are a nuisance to most parts of America between the tropics."

ACARUS, THE MITE, OR TICK.

GENERIC characters, Mouth without proboscis; sucker with a cylindrical two-valved sheath; feelers two, compressed, and as long as the sucker; eyes two, placed one on each side the head; legs eight;

in

inmost of the species the antennæ are filiform; jointed, and resembling legs. This tribe contains 86 species, many of which have been inaccurately placed in the genus of lice. The ticks are all produced from eggs; the females being oviparous. Many of the species are carnivorous, and prey upon man, as well as other living creatures. When, however, this food is not to be procured, they are capable of deriving their subsistence from plants and vegetables. The dysentery and the itch, two insupportable diseases, are both occasioned by some of the smaller acari insinuating themselves into the human body.

The DOG-TICK, *Acarus ricinus*.

Globular ovate; sometimes arrives nearly to the size of a small bean, and is of a livid brown colour, with paler and darker variegations. This animal is furnished between the antennæ with a strong, broad, and flattened, snout or proboscis, edged on both sides by a row of strong, sharp, reversed prickles, which serve, when once introduced into the skin, to adhere with such a degree of tenacity as not to be easily removed. Infests dogs, and sometimes cattle.

The *Sheep-tick* is placed in this genus by the editor of the *Encyclopædia Londinensis*; it seems, however, to belong to the genus *Hippobosca*. See p. 424 of this volume.

The CHEESE-MITE, *Acarus firo*.

Specific character, whitish with ferruginous head and thighs; abdomen bristly. To the naked eye, the mites appear like moving particles of dust; but the microscope discovers them to be perfect animals, having as regular a figure, and performing all the functions of life as perfectly, as creatures that exceed them many times in bulk. The head is small in proportion to the body; and has a sharp snout, and a mouth that opens and shuts like a mole's. They have two small

eyes, and are extremely quick-sighted; and, when they have been once touched with a pin, you will easily perceive how cunningly they avoid a second touch. Their legs are each furnished at the extremity with two little claws, with which the animal very nicely takes hold of any thing. The hinder part of the body is plump and bulky; and ends in an oval form, from which there issue out a few exceeding long hairs. Other parts of the body are also beset with thin and long hairs, and even these hairs are bristly. The males and females are easily distinguished in these little animals. The females are oviparous, as the louse and spider; and from their eggs the young ones are hatched in their proper form, without having any change to undergo afterwards, except that at first they have only six legs. They are, however, when first hatched, extremely minute; and, in growing to their full size, they cast their skins several times. These little creatures may be kept alive many weeks between two concave glasses, and applied to the microscope at pleasure. They are thus often seen *in coitu*, conjoined tail to tail; and this is performed by an incredibly-swift motion. Their eggs, in warm weather, hatch in twelve or fourteen days; but in winter they are much longer. These eggs are so small, that a regular computation shows, that ninety millions of them are not so large as a common pigeon's egg. They are very voracious animals, and have often been seen to eat one another. Their manner of eating is by thrusting alternately one jaw forward and the other backward, and in this manner grinding their food: and, after they have done feeding, they seem to chew the cud. There are several varieties of this species found in different substances besides cheese; as in malt-dust, flour, oatmeal, &c. Those in malt-dust and oatmeal are much nimbler than the cheese-mites, and have longer hairs.

The

The HARVEST-BUG, *Acarus autumnalis*.

Specific character, globular ovate, colour red, abdomen bristly behind. This troublesome insect will make itself sufficiently known to most people during the months of July, August, and September: it is easily distinguishable on the skin by its bright red colour, and adheres so tenaciously when it has once fixed itself, as to be scarcely separated without violence; its motion, when disengaged, is pretty quick, though by no means equal to that of some other Acari. On the part where it fixes its causes a tumor, generally about the size of a pea; sometimes much larger, accompanied by a severe itching. These insects abound on vegetables, and are generally contracted by walking in gardens, amongst long grass, or in corn-fields. According to Mr. White, in his History of Selborne, they abound to an uncommon degree in the chalky districts of that part of Hampshire. He relates that he has been assured that the warreners, in the chalky downs, are so much infested by them, and that they swarm to so infinite a degree as to discolour their nets, and give them a reddish cast, while the men are so bitten as to be thrown into fevers.

The ITCH-INSECT, *A. scabiei*, *A. exulcerans*.

Specific character, white with reddish legs, the four hinder ones very long. This is a species of singular curiosity, not only from the unusual structure of its limbs, but on account of the many controversies relative to its real existence in the particular disease which it has been supposed to produce. In order to take a general view of this subject, more curious, it must be confessed, than delicate, we must revert to the decline of the seventeenth century, when Dr. Bononio, an Italian physician, communicated to Redi a description, accompanied by microscopic figures, of the present species of mite, which he believed, from his frequently-repeated observations on persons affected

fectcd with the complaint above-mentioned, to be the sole cause of the disease. The account of Bononio was introduced by Dr. Mead into the Philosophical Transactions, and may be found in No. 283 of that work. The observation seems to have been received both in England and elsewhere, as a new and curious discovery. That what may be not improperly called the acarine itch was however known in very ancient times is sufficiently clear from the observations of Mouffett, who, in his History of Insects, has given a short abstract of what the older writers have said on the subject, as well as a convincing proof that the complaint was well known in his own days. He relates the case of a Lady Penruddock, aged sixty, who contracted this disorder, as was supposed, by too long a continuance of goat's milk, which she took from apprehension of an approaching consumption. She was, says Mouffett, miserably afflicted with these mites, which the more they were picked out with needles by her nurses, the more their numbers seemed to increase; and at length she fell a victim to the disease.

This animal is of a slightly-rounded, sublobated, and somewhat-flattened, shape, with the thighs of the two upper pair of legs extremely thick and short, but the tarsi or continuations very slender, apparently tubular, transparent, and terminating in a rounded tip: the two lower pair of legs have thick oval oblong thighs, proceeding from a very slender base, and are extended into an extremely long, stout, curved, and sharp-pointed, bristle. The figure of this insect by Bononio, engraved in the Philosophical Transactions, cannot be commended either for elegance or accuracy: that of Degeer is sufficiently correct.

The TREE-MITE, *Acarus baccarum*.

This is a small species. The skin is smooth, shining, and glossy; and the whole animal seems distended, and ready to burst; the colour is a bright red, but a little

little duskier on the sides than elsewhere: the head is very small, and the legs short; there is on each side a dusky spot near the thorax, and a few hairs grow from different parts of the body. It is most common on currant and gooseberry bushes.

The INSECT-MITE, *A. coleoptratorum*.

Oval, rufous, with a whitish tail. Extremely minute: its body is round, reddish, and covered with a hard skin; the head is very small, the neck scarcely visible: the legs are moderately long, the anterior pair longer than the others: it has a whiteness about the anus. It is frequent on the bodies of many coleopterous insects; it runs very swiftly: the humblebee and many other of the larger insects are infested with it; but none so much as the common black beetle, which has thence been called the lousy beetle.

The VEGETATING MITE, *Acarus vegetans*.

So called from the very curious manner in which it is fixed to the limbs or wing shells of the insect it infests; viz. by a stem or footstalk of considerable length, proceeding from the end of the body, and resembling a tail. This species is much smaller than the preceding, but of similar colour: its shape is nearly hemispherical, the upper or convex part being of a lucid surface. Dr. Shaw was inclined to suppose this insect in reality nothing more than the young of the *Acarus coleoptratorum*, and that the eggs of that species are deposited on a footstalk, in the same manner as those of the *Hemerobius perla*. See p. 321 of this volume.

HYDRACHNA, THE WATER-MITE.

GENERIC characters, Head, thorax, and abdomen, united or connate; feelers two, jointed; eyes two, four, or six; legs eight, formed for swimming. The genus *Hydrachna*, allied in the closest manner

to that of *Acarus*, under which the only species known to Linnæus were arranged, was first instituted by the ingenious Muller, by whose industrious researches many new and curious kinds have been discovered. They are inhabitants of stagnant waters, and swim with great velocity; they prey on the larvæ of *Tipulæ* and *Monoculi*. The eggs are red, and at first spherical, but afterwards become semilunar. The larva is six-footed, and furnished with a very singular proboscis. There are 49 species.

THE TAILED WATER-MITE, *Hydrachna buccinator*.

Specific character, eyes two, a cylindrical yellow tail narrowed at the base. Shape obovate; colour red, black behind and underneath; eyes reddish, legs black. A small species, inhabiting the banks of stagnant waters.

THE GEOGRAPHICAL WATER-MITE, *H. geographica*.

So named from the fancied map-like distribution of its variegations. It is one of the largest of the genus, and occasionally seen in clear ponds and other stagnant waters, but is one of the rarer kinds: its shape is globular, and its colour a polished black, decorated with carmine-coloured spots and patches, which, in a certain light, are accompanied by a kind of gilded lustre: four round spots of this colour are situated on the middle of the upper part of the body, and are bounded by four larger angular patches; besides which, on the sides and lower part of the body, are some others: the legs are varied with black and red, and, as in the rest of the genus, beautifully ciliated with long hairs; eyes two. This insect swims with great celerity, and appears in almost constant motion. When seen in its state of perfection, it may be numbered among the most beautiful of the British insects.

PHALANGIUM,

PHALANGIUM, THE PHALANGIUM.

GENERIC characters, Legs eight; eyes, two vertical, and two lateral; front furnished with two or four cheliform feelers; antennæ none; abdomen generally rounded. Of all the insects in this order, few perhaps will be found of a form more repulsive than that of the present genus, which, exclusive of its spider-like shape, is, in some species, armed with weapons resembling those of the genus *Aranea*, but operating with greater malignity. The Phalangia differ very much in size, some being very minute insects, while others are equal in magnitude to the larger kind of spiders. Some have imagined that all those threads with which the grass and stubbles in autumn are covered, are the production of the Phalangia. So numerous are these threads, that in the course of one day the whole surface of the ground is covered with them. Their uses to the animal are probably to ensnare its prey, and to assist it in travelling through the air. The legs are uncommonly long, and slender: when caught by one of them, the owner parts with it to save his body, and makes off without much apparent uneasiness: this is also the case both with the crab and lobster, whose loss is quickly repaired by the growth of a new limb. No experiments have yet ascertained whether the power of reproducing their limbs may not also belong to the insects of this genus.

The LONG-LEGGED PHALANGIUM, *Ph. opilio*.

Specific character, abdomen ovate, colour grey, whitish beneath. This is called the long-legged, shepherd, or harvest, *spider*, being popularly considered as such, though differing very considerably from spiders properly so named. During the autumn it may be observed in gardens, about walls, &c. It is remarkable for its plump, but flattish, orbicular body, and its extremely long and slender legs, which are generally

rally so carried that the body appears suspended or elevated to a considerable height above the surface on which the animal rests: the eyes are situated on the top of the head, and resemble two very minute glassy globules: the colour of the whole animal is a pale greyish brown. This species preys on the smaller kind of insects in general.

The SPIDER PHALANGIUM, *Ph. araneoides*.

Of a large size and lengthened form; colour brown, covered with downy hair: the claspers are short, but very large in proportion to the animal, and the tips are toothed internally, in such a manner as to bear a resemblance to a lobster's claw. This insect is a native of the warmer parts of the south of Europe, and of Africa, inhabiting fields, and by its bite producing most painful swellings on the skin, and even, as it is said, sometimes death. Mr. Herbst, in his excellent work on the Aptera, has ranked this species, with some others of a similar appearance, under a distinct genus by the name of Solpuga.

The CRAB-LIKE PHALANGIUM, *Ph. cancroides*.

A very small insect, of a reddish-brown colour, and of a slow motion, occasionally found among papers, dried plants, &c. &c. Its shape is obtusely oval, with a sharpened front, furnished with a pair of very long and large jointed claspers, which give the insect a crab or lobster-like appearance: the body is very much depressed. This little insect has been occasionally referred to very different genera. The celebrated Swammerdam considered it as a species of Scorpion; and of the same opinion was the ingenious Roefel, in whose work on insects it is well figured. In the Fauna Suecica of Linnæus it is made an Acarus, and Degeer institutes for it a particular genus under the name of Chelifer. It is a species which seems to vary considerably in size; those which are found in

our

our own country rarely exceeding the length of the tenth of an inch, while in some parts of Europe it appears to arrive at twice that length. It is said by Linnæus, but probably on no just foundation, to introduce itself occasionally under the skin, and to excite a painful tumor; a circumstance, which, considering the size of the animal, seems scarcely possible. It preys on the smaller and weaker kind of insects, as the *Termes pulsatorium*, the larvæ of *Ptini* and *Dermestides*, &c.

The KIDNEY-SHAPED PHALANGIUM, *Ph. reniforme*.

One of the largest of the genus. This animal is a native of the hotter regions of the globe, being found in Africa and South America. It has the general appearance of a very large spider, with the thorax rather kidney-shaped, and the abdomen rounded: the legs are very long, and the palpi or claspers are strongly toothed on the inner side by several sharp-pointed curved processes: the first pair of legs have all the appearance of a pair of antennæ; far exceeding the rest in length, and being of a slender or filiform shape. The whole insect is of a deep chestnut-brown colour, with a yellowish cast on the abdomen. Its particular history seems to be little known; but there can be no doubt of its being of a predacious nature, living, probably, on the smaller insects.

The TAILED PHALANGIUM, *Ph. caudatum*.

Of rather smaller size than the former, and of a lengthened shape, with shorter limbs in proportion: it is principally distinguished by the long setaceous process in which the abdomen terminates: the chelæ or claspers are large, and toothed on the inside towards the tips. The general colour of the animal is chestnut brown: it is a native of the East Indies; and has the appearance of a lobster in miniature.

ARANEÆ, THE SPIDER.

GENERIC characters, Legs eight; eyes eight, sometimes six; mouth furnished with two hooks or holders; feelers two, jointed, the tips of which, in the male, distinguish the sex; antennæ none; abdomen terminated by papillæ or teats, through which the insect draws its thread. The holders, or claws, or forceps, stand horizontally, and, when not exerted for use, are concealed in two cases contrived for their reception, in which they fold like a clasp-knife, and there lie between two rows of teeth. A little below the point of each claw there is a small hole, through which Leeuwenhoek supposes the spider emits a kind of poison; but Dr. Mead, in his "Essay on Poisons," dissents wholly from this opinion, having never been able, on repeated examinations, to discover any such opening, not even in the claws of the largest foreign spider; which, being above fifty times larger than any of the European spiders, would more easily have afforded a view of this opening, if nature had allotted any to this part of the animal. Besides, repeated observations also convinced him that nothing dropped out of the claws, which went always dry while the spider bit any thing, but that a short white proboscis was at the same instant thrust out of the mouth, which instilled a liquor into the wound. And the same author observes, that the quantity of liquor emitted by our common spiders when they kill their prey, is visibly so great, and the wounding weapons so minute, that they could contain but a very inconsiderable portion thereof, if it were to be discharged that way. Spiders frequently cast their skins, which may be found in the webs, perfectly dry and transparent; and from such skins the forceps, or claws, for they are always shed with the skins, may easier be separated, and examined with much greater exactness than in the common spider while living.

Spiders

Spiders have five tubercles, or nipples, at the extremity of the abdomen, whose apertures they can enlarge or contract at pleasure. It is through these apertures that they spin a gluey substance with which their web is formed. They fix the end of their threads by applying these nipples to any substance, and the thread lengthens in proportion as the animal recedes from it. They can stop the issuing of the threads by contracting the nipples, and re-ascend by means of the claws on their feet, much in the same manner as some men warp up a rope. When the common house-spider begins her web, she generally chooses a place where there is a cavity, such as the corner of a room, that she may have a free passage on each side, to make her escape in case of danger. Then she fixes one end of her thread to the wall, and passes on, dragging the thread along with her, till she arrives at the other side, and there fixes the other end of it. Thus she passes and repasses, till she has made as many parallel threads as she thinks necessary for her purpose. After this, she begins again, and crosses these by other parallel threads, which may be named the *woof*. These are the toils or snares which she prepares for entangling flies, and other small insects. But, besides this large web, she generally weaves a small cell for herself, where she lies concealed watching for her prey. Betwixt this cell and the large web she has a bridge of threads, which, by communicating with the threads of the large one, both give her early intelligence when any thing touches the web, and enables her to pass quickly in order to lay hold of it. The tubercles or papillæ are furnished with numerous apertures that do the business of wire-drawers, as it were, in forming the threads. Of these apertures M. Reaumur observes, there are enough in the compass of the smallest pin's head to yield a prodigious quantity of distinct threads. M. Reaumur has often counted seventy or eighty with a microscope, but perceived that

that there were infinitely more than he could tell. In effect, if he should say that each tip of a papilla furnished a thousand, he is persuaded he should say much too little; consequently the spider, having five papillæ, has holes for about five thousand threads. Such is the tenuity of the threads in the larger sort of spiders. But, if we examine the young produced by those, we shall find that they no sooner quit the egg than they begin to spin. Indeed their threads can scarcely be perceived, but the webs may: they are frequently as thick and close as those of house-spiders; and no wonder, there being often four or five hundred little spiders concurring to the same work. How minute must their holes be! the imagination can scarcely conceive that of their papillæ! The whole spider is perhaps less than a papilla of the parent which produced it. But there are even some kinds of spiders so small at their birth, that they are not visible without a microscope. There are usually found an infinity of these in a cluster, and they only appear like a number of red points; and yet there are webs found under them, though almost imperceptible. What must be the tenuity of one of these threads? Mr. Leeuwenhoek has computed that one hundred of the single threads of a full-grown spider are not equal to the diameter of the hair of his beard; and consequently, if the threads and hair be both round, ten thousand such threads are not larger than such a hair. He calculates farther, that, when young spiders first begin to spin, four hundred of them are not larger than one which is of a full growth: allowing which, four millions of a young spider's threads are not so large as the single hair of a man's beard!

Garden-spiders, particularly the short-legged species, yield a kind of silk, which has been judged little inferior to that of the silk-worm. Mr. Bon, of Languedoc, contrived to manufacture from it a pair of silk stockings and mittens, of a beautiful natural grey colour,

colour, which were almost as handsome and strong as those made with common silk; and he published a dissertation concerning the discovery. But M. Reaumur, being appointed by the Royal Academy to make a farther inquiry into this new silk-work, raised several objections against it, which are printed in the Memoirs of the Academy for 1710. The sum of what he has urged amounts to this: The natural fierceness of spiders renders them unfit to be bred and kept together: four or five thousand being distributed into cells, fifty in some, one or two hundred in others, the large ones soon killed and ate the less, so that, in a short time, there were scarcely left one or two in each cell; and to this inclination of devouring one another, M. Reaumur ascribes the scarcity of spiders, considering the vast number of eggs they lay; besides, they are devoured in their turn by the numerous species of the *Sphex* and *Ichneumon*. But this is not all: he affirms, that the spider's bag is inferior to that of the silk-worm both in lustre and strength, and that it produces less matter to be manufactured. The thread of the spider's web, he says, only bears a weight of two grains without breaking; and that of the bag bears thirty-six. The latter, therefore, in all probability, is eighteen times thicker than the former: yet it is weaker than that of the silk-worm, which bears a weight of two drachms and a half: so that five threads of the spider's bag must be put together to equal one thread of the silk-worm's bag. Now it is impossible these should be applied so justly over one another as not to leave little vacant spaces between them, whence the light will not be reflected; and, of consequence, a thread thus compounded must fall short of the lustre of a solid thread. Add to this, that the spiders thread cannot be wound off, as that of the silk-worm may, but must of necessity be carded; by which means, being torn in pieces, its evenness, which contributes much to its lustre, is destroyed. In effect,
this

this want of lustre was taken notice of by M. de la Hire, when the stockings were presented to the academy. Again, spiders furnish much less silk than the worms: the largest bags of these latter weigh four grains, the smallest three grains; so that 2304 worms produce a pound of silk. The spider-bags do not weigh above one grain; yet, when cleared of their dust and filth, they lose two-thirds of their weight. The work of twelve spiders, therefore, only equals that of one silk-worm; and a pound of silk will require at least 27,648 spiders. But as the bags are wholly the work of the females, who spin them to deposit their eggs in, there must be kept 55,296 spiders to yield a pound of silk. Yet will this only hold of the best spiders; those large ones ordinarily seen in gardens, &c. scarcely yielding a twelfth part of the silk of the others. Two hundred and eighty of these, he proves, would not yield more than one silk-worm; 663,552 of them would scarcely yield a pound.

The act of generation among spiders varies in different species. As these insects prey upon each other except during the time of their amours, they dare not come within reach of one another but with the utmost caution. They may sometimes be seen stretching out their legs, shaking the web, and tampering with each other by a slight touch with the extremity of their feet; then, in a fright, dropping hastily down their thread, and returning in a few moments to make fresh trial by feeling. When once both parties are well assured of the sex they have to deal with, the approaches of their feet, in order to feel, become more frequent, confidence takes place, and the instant of amorous dalliance ensues. "We cannot," says Lyonnet, "but admire how careful they are not to give themselves up blindly to a passion, or venture on an imprudent step, which might become fatal to them." A caveat this to the human kind. Lister and Lyonnet, two accurate observers, say, that the extremity

mity of those arms, or claws, which the spider uses to grasp his prey with, suddenly opens, as it were by a spring, and lets out a white body, which the male applies beneath the abdomen of the female, to fulfil the wish of nature. In the water-spider, the sexual organs are situated at the hinder parts of the male, are curved, and act as it were by a spring; those of the females are distinct. Nature by a thousand varied methods accomplishes her purpose.

Spiders frequently change their colour, which varies much, in respect to season, sex, age, &c. but they are in general more beautifully variegated in autumn; a season not only the most opportune and plentiful respecting their prey, but the time when they arrive at their greatest magnitude, and are in their height of vigour. The natural longevity of the spider is greater than seems to have been granted to the generality of the insect tribes. The length of its life is not exactly ascertained; but it probably endures for several years. The female, it is said, does not begin to lay her eggs till she has completed her second year; and even then, her brood is not so numerous as when she has attained her full maturity. When that period arrives, she has been known to produce near a thousand eggs in a single season. The species of aranea now known, amounts to no less a number than 123; they are distributed into fourteen divisions, the eyes being placed in so many different positions. We shall however notice, and figure, a few of the most remarkable species, without any regard to these divisions.

The WANDERING SPIDER, *Aranea viatica*.

It varies in colour, being sometimes brown, sometimes yellow, sometimes whitish, and sometimes green; the abdomen is large, with two bands of dark orange, which arising from the thorax descend obliquely on the sides towards the middle; between the bands are

a few small black dots, forming a kind of triangle upon the middle of the abdomen; on the thorax are seen two longitudinal bands somewhat green, one on each side. The two foremost pair of legs are very long, and the hinder short, which makes it walk sideways like a crab. It is found upon plants, and is a lively, active, indefatigable, hunter. Without any motion of the head, which is furnished with immoveable eyes, it perceives all the flies that hover round about, does not scare them, but stretches over them its arms furnished with feathers, which prove nets in which their wings intangle. It is said to sit on its eggs, which however it often carries about with it, wrapped up in a ball of white silk.

The BARBARY SPIDER, *Aranea fasciata*.

Silvery, with yellow bands round the belly, and dusky hairy jointed legs; is a native of Barbary, and as large as the thumb. It inhabits hedges and thickets: its webs have large meshes, and it resides in the centre upon its nest. The snares are spread for large flies, wasps, drones, and even locusts. The animal which it entangles is soon killed by the spider, and partly eaten, if the spider be hungry; the rest is concealed under some neighbouring dry leaves, covered with a kind of web, and a blackish glue in great abundance. Its larder is often plentifully stored. Its nest is about the size of a pullet's egg, divided horizontally, and suspended by the threads of the insect, which are of a silvery white, and stronger than silk. It carries its eggs in a little bag under its belly, from which the young ones come out, and for a time in the same web live in amity; but, when grown up, are mortal enemies. They never meet but they fight with violence, and their battle only ends with the death of the weakest. The dead body is carefully stored in the larder. Twelve of these spiders, by way of experiment, were shut up together; and, after a battle of eight

the web.

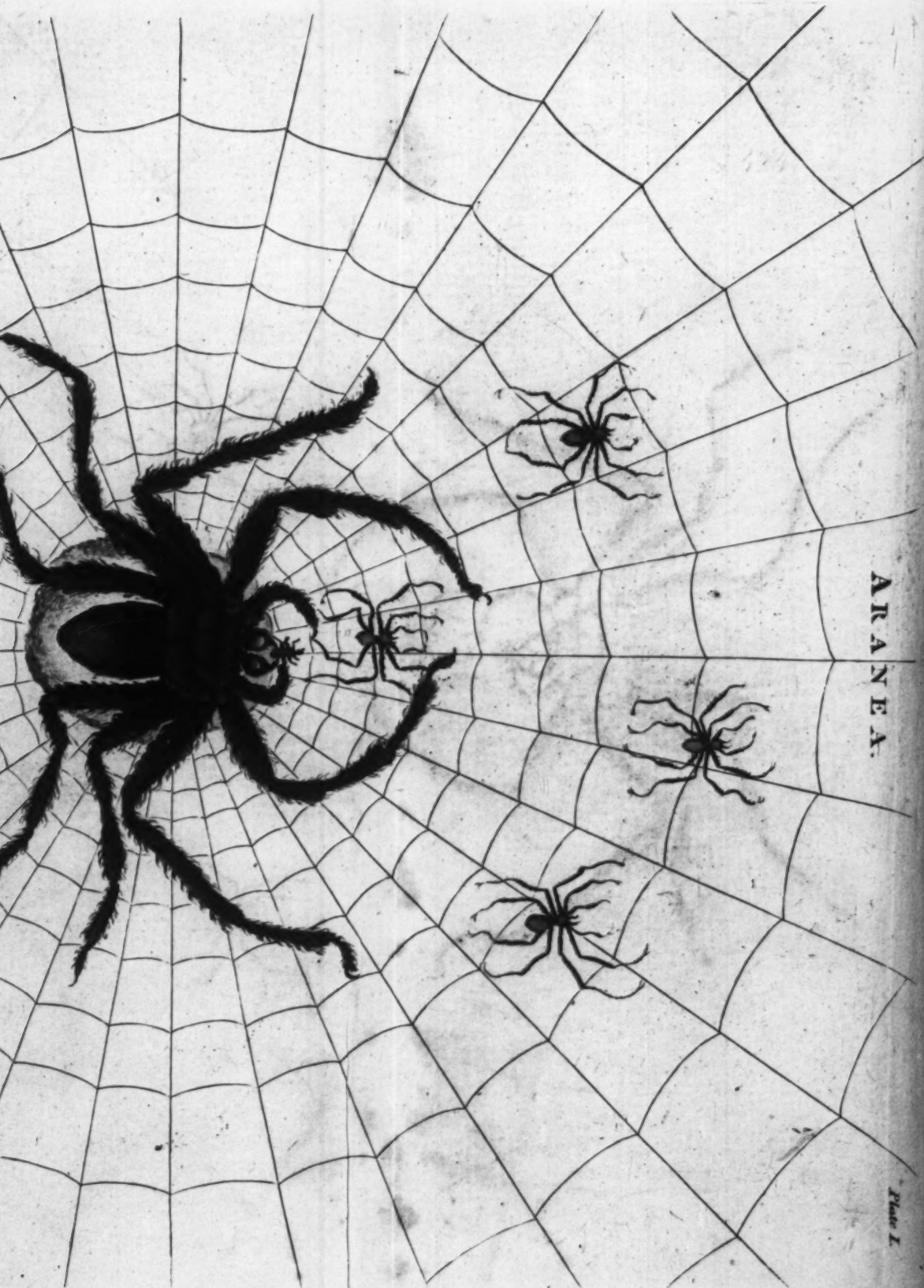
The Tarantula, or Barbary Spider.

London: Published at the late deceased Author's Widow's, by J. Millar.

1750. and



ARANEÆ.



eight days, the strongest only remained alive. *Aranea* Plate I. exhibits this spider on its nest, in the centre of its web, feasting on its prey, from a very exact and curious drawing.

The CROWNED SPIDER, *Aranea diadema*.

This is the largest spider which England produces. The abdomen is of an oval form, downy, and of a ruddy yellow colour, which is very variable in different seasons; being sometimes paler, at others very dark coloured. The upper part is beautifully adorned with black and white circles and dots, having a longitudinal band in the middle, composed of oblong and oval-shaped pearl-coloured spots, so arranged as to resemble a fillet, similar to those worn by the eastern kings. The ground upon which this fillet and the white dots are laid, when viewed with a glass, and the sun shining thereon, is beautiful and rich beyond all description. There are varieties in colour of this spider when young; some have their abdomen purple, ornamented with white dots, the legs yellow and annulated with a deeper colour; and others have their abdomen of a fine red, ornamented with white, and the legs of a fine pale green colour, annulated with dark purple or black. It inhabits the birch-tree.

The WATER SPIDER, *Aranea aquatica*.

Of a livid colour, with an oval belly, and a transverse line with two hollowed points. It frequents the fresh waters of Europe, but is in some sort amphibious; for it can live on land as well as in the water, and comes often on shore for its food; yet it swims, both on its belly and back: and it is distinguishable by its singular brightness. In the water its belly appears covered with a silver varnish, which is only a bubble of air attached to the abdomen by means of the oily humours which transpire from its body, and prevent the immediate contact of water. This bubble

of air is made the substance of its dwelling, which it constructs under water; for it fixes several threads of silk, or such fine matter, to the stalks of plants in the water; and then, ascending to the surface, thrusts the hinder part of its body above water, drawing it back again with such rapidity, that it attaches underneath a bubble of air, which it has the art of detaining under water, by placing it underneath the threads above-mentioned, and which it binds like a covering almost all around the air-bubble. Then it ascends again for another air-bubble; and thus proceeds until it has constructed a large ærial apartment under water, which it enters into or quits at pleasure. The male constructs one for himself near the female; and, when love invites, he breaks through the thread walls of the female's dwelling, and the two bubbles attached to the bellies of both unite into one, forming one large nuptial chamber. The female is sometimes laid for a whole day together stretched on her back, waiting for the arrival of the male, without motion, and seemingly as if dead. As soon as he enters, and glides over her, she seems to be brought to life again, gets on her legs and runs after the male, who makes his escape with all possible speed. The female takes care of the young, and constructs similar apartments on purpose for them. The figure of this spider has nothing remarkable; and would be overlooked among a crowd of curiosities, if the spectator were unacquainted with its singular art of constructing an ærial habitation under water, and thus uniting together the properties of both elements.

The TARANTULA, *Aranea tarantula*.

Breast and belly ash-colour; legs ash-coloured, with blackish rings on the under-part; the fangs or nippers are red on the inner side, the rest being blackish: two of its eyes are larger than the other, red, and placed in the front; four other eyes are placed in a transverse

transverse direction towards the mouth ; the other two are nearer the back. It is a native of Italy, Cyprus, Barbary, Corfica, Persia, and the East Indies. It lives in bare fields, where the lands are fallow, but not very hard ; and, from its antipathy to damp and shade, chooses for its residence the rising part of the ground facing the east. Its dwelling is about four inches deep, and half an inch wide ; at the bottom it is curved, and there the insect sits in wet weather, and cuts its way out if water gains upon it. It weaves a net at the mouth of the hole. These spiders do not live quite a year. In July they shed their skin, and proceed to propagation ; which from a mutual distrust, as they frequently devour one another, is a work undertaken with great circumspection. They lay about seven hundred and thirty eggs, which are hatched in the spring ; but the parent does not live to see her progeny, having expired early in the winter. The ichneumon fly is their most formidable enemy.

The bite of the tarantula is said to occasion an inflammation of the part, which in a few hours brings on sickness, and universal lassitude. The person afterwards is affected with a delirium, and sometimes is seized with a deep melancholy. The same symptoms are said to return annually, in some cases, for several years, and at last terminate in death. Music, it has been pretended, is the only cure. A musician is brought, who tries a variety of airs, till at last he hits upon one that urges the patient to dance ; the violence of which exercise produces a proportionable agitation of the vital spirits, attended with a consequent degree of perspiration, the certain consequence of which is a cure. Such are the circumstances that have been generally related, and long credited, concerning the bite of this spider. Kircher, in his *Musurgia*, gives a very particular account of the symptoms and cure, illustrated by histories of cases. Baglivi, an eminent Italian physician, native of Apulia, the

the country where the tarantula is produced, has written a dissertation *De Anatomia, Morfu, et Effectibus, Tarantulae*. In this he describes the region of Apulia where the tarantula is produced, with the anatomy and figure of the insect and its eggs, illustrated by an engraving; he mentions particularly the symptoms that follow from the bite, and the cure of the disease by music, with a variety of histories of cures thus wrought, many of them communicated by persons who were eye-witnesses of the process. Ludovicus Valetta, a Celestine monk of Apulia, also published at Naples, in 1706, a treatise upon this spider, in which he not only answers the objections of those who deny the whole matter; but gives, from his own knowledge, several instances of persons who had suffered by the bite of the tarantula. Mr. Boyle, likewise, in his treatise of "Languid and unheeded Motions," speaking of the bite of the tarantula, and the cure of the disease which follows it by means of music, says, That, having himself had some doubts about the fact, he was, after strict enquiry, convinced that the relations in the main were true. And lastly, Dr. Mead, in his "Mechanical Account of Poisons," has given an essay on the tarantula, containing the substance of the above relations, which he strenuously endeavours to confirm.

Yet, notwithstanding the number and weight of these authorities, and the general acquiescence of learned and ingenious men in the opinion that the bite of the tarantula is poisonous, and that the cure of the disorder occasioned by it is effected by music, we have reason to apprehend that the whole is a mistake. In the Philosophical Transactions for the year 1672, p. 406, is an extract of a letter from Dr. Thomas Cornelio, a Neapolitan physician, to John Doddington, Esq. his majesty's resident at Venice, communicated by the latter, in which, speaking of his intention of sending to Mr. Doddington some tarantulas,

ho

he says, " Meanwhile I shall not omit to impart to you what was related to me a few days since by a judicious and unprejudiced person; which is, that, being in the country of Otranto, where those insects are in great numbers, there was a man, who, thinking himself stung by a tarantula, showed in his neck a small spot, about which in a very short time there arose some pimples full of a serous humour; and that, in a few hours after, the poor man was sorely afflicted with violent symptoms, as syncope, very great agitations, giddiness of the head, and vomiting; but that, without any inclination at all to dance, and without a desire of having any musical instruments, he miserably died within two days. The same person affirmed to me, that all those that think themselves bitten by tarantulas, except such as for evil ends feign themselves to be so, are for the most part young wanton girls, whom the Italians call *dolci di sale* (half-witted); who, by some particular indisposition falling into this melancholy madness, persuade themselves, according to the vulgar prejudice, to have been stung by a tarantula."

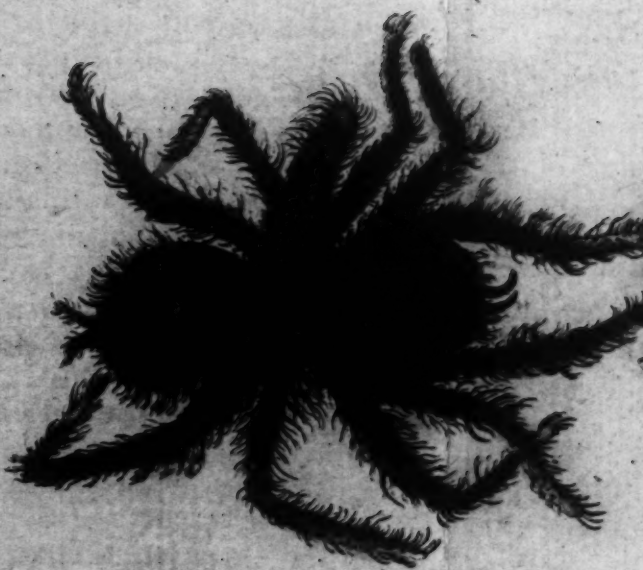
Dr. Serao, an Italian physician, has written an ingenious book, in which he has effectually exploded this opinion as a popular error; and in the *Philosophical Transactions*, No. LX. for the year 1770, p. 236, is a letter from Dominico Cirillo, M. D. professor of natural history in the university of Naples, wherein, taking notice of Serao's book, he says, That having had an opportunity of examining the effects of this animal in the province of Taranto, where it is found in great abundance, he is convinced that the cure of the bite of the tarantula by music has not the least truth in it; and that it is only an invention of the people, who want to get a little money by dancing, when they say the tarantism begins. He adds, " I make no doubt but sometimes the heat of the climate contributes very much to warm their imaginations,

imaginations, and throw them into a delirium, which may be in some measure cured by music; but several experiments have been tried with the tarantula, and neither men nor animals, after the bite, have had any other complaint than a trifling inflammation upon the part. In Sicily, where the summer is still warmer than in any part of the kingdom of Naples, the tarantula is never thought dangerous; and music is never employed for the cure of the pretended tarantism."

Mr. Swinburne, when in the country of the tarantula, was desirous of investigating minutely every particular relative to that insect; but the season was not far enough advanced, and no *tarantati* (persons bitten, or pretending to be bitten, by the tarantula) had begun to stir. He prevailed, however, upon a woman who had formerly been bitten, to act the part, and dance the tarantata before him. A great many musicians were summoned, and she performed the dance, as all present assured him, to perfection. At first she lolled stupidly on a chair, while the instruments were playing some dull music. They touched, at length, the chord supposed to vibrate to her heart; and up she sprung with a hideous yell, staggered about the room like a drunken person, holding a handkerchief in both hands, raising them alternately, and moving in very true time. As the music grew brisker, her motions quickened, and she skipped about with great vigour and variety of steps, every now and then shrieking very loud. The scene was far from pleasant; and, at his desire, an end was put to it before the woman was tired. Wherever the *tarantati* are to dance, he informs us, a place is prepared for them, hung round with bunches of grapes and ribbons. The patients are dressed in white, with red, green, or yellow, ribbons, those being their favourite colours; on their shoulders they cast a white scarf, let their hair fall loose about their ears, and throw their heads as

far

The do.

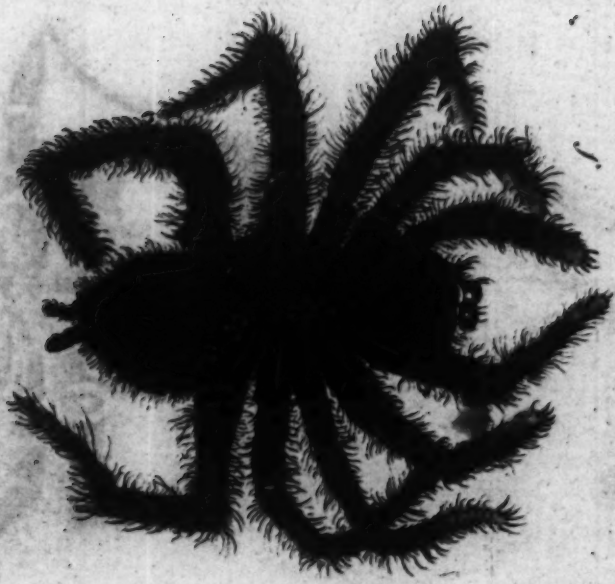


The Spicularia, Tarantula, and Striped Spider.

London, Printed at the ...

Page only

ARANEÆ.



far back as possible. They are exact copies of the ancient priestesses of Bacchus. The orgies of that god, whose worship, under various symbols, was more widely spread than that of any other divinity, were no doubt performed with energy and enthusiasm by the lively inhabitants of this warm climate. The introduction of Christianity abolished all public exhibitions of these heathenish rites, and the women durst no longer act a frantic part in the character of Bacchantes. Unwilling to give up so darling an amusement, they devised other pretences; and possession by evil spirits may have furnished them with one. Accident may also have led them to the discovery of the tarantula; and, upon the strength of its poison, the Puglian dames still enjoy their old dance, though time has effaced the memory of its ancient name and institution; and this Mr. Swinburne takes to be the origin of so strange a practice. If at any time these dancers are really and involuntarily affected, he supposes it can be nothing more than an attack upon their nerves, a species of St. Vitus's dance; and he inclines the more to the idea, as there are numberless churches and places throughout these provinces dedicated to that saint.

There are several varieties of the tarantula, some hairy, and some smooth. The figures *a*, *b*, *c*, *d*, in the Aranea Plate II. represent four of these spiders, brought from Tarenti, in Italy, where they very much abound, and whence it is supposed the name *tarantula* is derived.

The GREAT AMERICAN SPIDER, *Ar. avicularia*.

This is one of the largest species of the tribe. Its back is covered with a hard, thick, brown coat, hollowed at the sides, and cleft transversely across the middle, as if it had a hole in that place. The head is small, and with difficulty distinguished from the corselet. The mouth is furnished with brown, hard, crooked

crooked, teeth. The body is large and rotund, growing out into two parts. The whole body, except the back, and all the six feet, are covered with long bushy hair; an exact representation of which is delineated in the same Plate, at letter *e*. *f* shows the under part of the same spider, which, it may be observed, is of a brown colour, and the rings of the feet alternately white and red. The extremities of the feet are smooth, and large, like the toes of a dog. Linnæus has given it the name of *avicularia*, because it principally attacks little birds. It tears them to pieces in a cruel manner to get at their blood, and afterwards sucks their eggs. See the smaller Plate, where the spider is shown in the act of destroying a small bird.

The PRICKLY SPIDER, *Aranea aculeata*.

Six spines on the back. This singular species is found in the island of Curaçoa, in America. In the figure at *g*, of the *Aranea* Plate II. may be seen the upper part of this spider; and at *h*, the under. It is brown, marked on both sides with an orange spot. It is found in the fields, under the roots of plants, or even in the houses in the country, but seldom or ever in towns. What is remarkable in its structure is, that it has but six feet, and a small mouth furnished with two teeth, like those of the *avicularia*, described above. It is said to have this fatal property, that, after having bitten a sheep or cow, if these animals drink water when wounded, it inevitably kills them in the space of twenty-four hours, and they expire in terrible convulsions. When a man is bitten, the cure is very difficult, and it is a chance if his life is saved. For they dare not give him any thing to quench his thirst but decoction of tobacco, urine, or spirit extracted from sugar, which has been hitherto found to be the best remedy. During the malady, the person is attacked with convulsions, delirium,

lirium, and other symptoms of a burning fever. We obtain this information from D. A. L. Muller, physician in the island of Curaçoa, who made a present of this insect to the curious cabinet of the celebrated naturalist G. W. Knorr.

SCORPIO, THE SCORPION.

GENERIC characters, Legs eight, besides two chelæ or hands seated on the fore-part of the head : eyes eight, three on each side of the thorax and two on the back : feelers two, projecting, cheliform : lip bifid ; antennæ none ; tail long, jointed, and terminated by a sharp crooked sting : on the under side, between the breast and abdomen, are two instruments resembling a comb. There are 10 species, whose specific characters are drawn from the number of teeth in the comb we have just mentioned ; but the number of teeth varies occasionally in the same species, so as to make this character uncertain ; nor is the use of this organ at present known.

The scorpion is proverbially famous for malignancy and for its poisonous sting ; but I believe we have none in Britain. In Italy, Spain, and the south of France, they are frequently to be met with three inches in length, and are considered as the greatest pests that torment mankind. But the size and malignity of the scorpions of Europe may be deemed trifling, when compared with that of the African monsters that are distinguished by that name. Along the Gold Coast they are sometimes found larger than a lobster, and their sting is inevitably fatal. From the language of Scripture, too, we find that in the east these animals have long been formidable to mankind. In Batavia, they sometimes grow twelve inches in length ; and in removing furniture, behind which they skulk, there is the utmost danger of being stung.

It is to M. de Maupertuis that the public is indebted for the first accurate and philosophical account of
 3 M 2 these

these animals. According to him, they are all viviparous; the body of the pregnant female exhibiting, when opened, between forty and fifty living young. Each of these is separated from the rest by a thin membrane, while all are united by a common filament. In order to ascertain the venom of their sting, that philosopher bred a great number together, and let them loose upon dogs and other animals; and he found that sometimes the sting was so empoisoned as to swell the whole body of the wounded animal; and in that case it brought on violent retching, convulsions, and death. At other times, whether from the difference of food, or some other cause, he found their sting harmless. No observations nor experiments of naturalists have yet enabled them to assign the cause why the sting of the scorpion, which at one time is fatal, proves harmless at another; nor has the medical art yet found out any certain antidote against its malignity. The efficacy of the oil of scorpions, and some other remedies that are used, is perhaps rather to be ascribed to the want of activity, or the total absence, of the poisonous matter. This poison is evacuated through two very small oblong foramina situated on each side the tip of the sting. It is well known that a diversity of opinion has subsisted among authors relative to this particular. The celebrated Redi, assisted by the best microscopes he could procure, was not able to detect any orifice, though he was well convinced of the existence of such, from observing a minute drop of poison exude from near the tip. Others have denied the existence of any foramen; but Vallisneri and Leeuwenhoek have properly described two foramina, viz. one on each side; so that the sting of the scorpion can with greater facility discharge its poisonous fluid than that of any other insect. A third foramen is said to have been sometimes observed.

The

The GREAT AFRICAN SCORPION, *Sc. Afer*.

Specific character, combs with 13 teeth, hands hairy. This is the largest and by far the most formidable of the genus. It often measures four inches from the head to the beginning of the tail, and ten inches, if measured from the tips of the clasps to that of the tail. Its colour is a dark brown, inclining to yellow beneath, and in the interstices of the joints; and the clasps have often a reddish cast. This species is found in many parts of Africa, where it is held in great dread; the effect of its sting producing very severe symptoms, and sometimes death.

The COMMON ITALIAN SCORPION, *Sc. Europæus*.

Combs with 18 teeth, hands angular. This measures about an inch in length from the head to the setting-on of the tail; but, if measured from the tips of the clasps to the tip of the tail, about three inches: its colour is brown, with considerable variation in different individuals, some inclining to a reddish, and some to a yellowish, cast. This animal is found in neglected places, beneath boards, stones, &c. and frequently makes its appearance in houses: its sting is painful, but seldom productive of any very serious consequences, and the usual remedy is sweet oil, well rubbed on the punctured part. Like the rest of the genus, this insect preys on other insects, and particularly on spiders.

CANCER, THE CRAB, LOBSTER, &c.

GENERIC characters, Legs eight, (sometimes ten or six,) besides the two large claws which answer the purpose of hands; eyes two, at a considerable distance from each other, and for the most part supported by a kind of pedunculi or footstalks; they are likewise elongated and moveable; feelers six; tail jointed. This genus includes the lobster, shrimp, &c. There are

are no less than 204 species, distinguished principally by the length of their tails and the margins of their breasts.

Crabs in general are aquatic animals, whose residence is in the sea: some, however, are known to frequent rivers; and in America, there are some species wholly terrestrial; these are commonly about four inches long, and feed upon leaves. The liquid substance found in their shell cures the blisters that are raised on the skin by the milky substance that exudes from the *mancinella* tree. The savages apply the fat, when melted down, as a specific against the rheumatism.

Some of the species, it is well known, are of a short, thick, and nearly orbicular, form; and sometimes the transverse diameter of the body considerably exceeds the longitudinal: others are of a thin and long form: some are strongly muricated; others perfectly smooth: some are furnished with very strong and large chelæ or claws; others have only weak unarmed feet: lastly, some are remarkable for their great size, while others are so diminutive as to require the assistance of glasses in order to determine the structure of their several parts.

The animals of this genus cast their shells from time to time. When this period approaches, the limbs gradually shrink or waste in size, so as to enable them to be drawn with greater ease from the claws and other parts of the shell. The animal then lies in a quiet state for some days, till the new shell is formed, or rather till it is hardened; for at first it is rather membranaceous than crustaceous. Some species have the body naturally destitute of a shelly covering; in consequence of which they never fail to take possession of such vacant univalve shells as happen to suit their convenience; the body being immersed in the shell, while the claws remain exerted.

The loss of a limb, an accident so dreadful and irremediable

irremediable to the major part of the animal world, is to these creatures but of little importance; since the space of a few weeks supplies the defect, and restores them to their former state. What is still more wonderful, these animals, when injured, maimed, or bruised on any particular limb, do not wait for the process of a gradual recovery of that individual part, but, as if conscious of the power of reproduction, voluntarily cast off with sudden violence the offending member, and betaking themselves to a state of retirement, await the formation of their new limb. Most of the genus are very prolific; the female of the common lobster is said to produce upwards of twelve thousand eggs each time of laying. In this genus also we find examples of deviation from that general symmetry of parts, so conspicuous in most other animals, in which the shape of the body and limbs on one side exactly corresponds to that of the other; many of the Cancræ being furnished with a pair of chelæ or claspers, which on one side are of an immoderate size, while those on the opposite side are thin and small; and in some particular species, as the *Cancer vocans*, &c. the size of the large arm is so great as to oblige the animal to support it on its back, in which position it is generally placed while the creature is walking.

The RED MOTTLED CRAB, *Cancer grapsus*.

Specific character, front deflected, and four-toothed before the tip; thorax smooth. The body is round; the legs longer and larger than in some other kinds; the claws red; except which the whole is mottled in a beautiful manner with red and white. These crabs inhabit the rocks hanging over the sea; they are very nimble, and run with surprising agility along the upright side of a rock, and even under the rocks that hang horizontally below the water. This they are often necessitated to do to escape the assaults of rapacious birds
that

that pursue them. These crabs never go to land ; but frequent mostly those parts of the promontories and islands of rocks in and near the sea, where, by the continual and violent agitation of the waves against the rocks, they are always wet, continually receiving the spray of the sea, which often washes them into it ; but they instantly return to the rock again, not being able to live under water, and yet requiring more of that element than any of the crustaceous kinds that are not fish.

The CRESTED CRAB, *Cancer cristatus*.

Specific character, thorax and legs prickly ; proboscis projecting, bifid, crested. This is of a beautiful red when boiled, but its natural colour is a dirty grey. The shell is very hard and thick ; the hinder part is large and round, and the fore part a little more pointed. On the surface of the shell are four particular excrescences ; besides which it is covered with a great number of hollow prickles ; and the flesh of the animal has so many erected points fashioned by these prickles, which are longest on both sides of the anterior part. Exactly in the middle of the head there are two of these prickles or horns, which are larger and longer than the rest. Under these two horns hangs a thin skin, which resembles the mouth of the locust ; and it is on account of this membrane that Linnæus calls this crab *cristatus*. On each side of these horns are the eyes, fixed in large orbs, and mounted on the ends of pedunculi or stems, which the crab moves backwards and forwards out of the orb, to enable him to see forward, backward, and aside. The feet consist of five distinct joints, and are furnished with little thorny points. The first part of the foot is short, the three next are long, and that at the extremity resembles the claw of a bird. The claws are armed with pincers, which resemble long and pointed nippers. The tail is composed of several joints, the
first



The Crustacean Crab, the Pagurus Crab, & the common Lobster.

Engraved by the late John Smith, Esq.

J. Thompson sculp.



CANCER

first of which is shorter than the rest, and they are all marked with cross stripes. It is the Indians and poor people only who eat them, since they are not of a very good flavour. They are found both in the East and West Indies, mostly concealed under the rocks covered with coral, where they retire in stormy weather. There are other subordinate varieties of them, which are more or less long or large, or which have the shell more arched, or the prickles more or less long. Neither is the colour always the same; for there are some that have the shell naturally white, and others spotted with red. In the water they generally row with their claws and feet. A figure of this singular species is given at the top of the Cancer Plate I.

The LARGE EATABLE CRAB, *Cancer pagurus*.

Thorax with nine plaits on each side, smooth body; unquedentated front; smooth claws and black tips; hind feet subulated. It inhabits the rocky coasts: is the most delicious meat of any; casts its shell between Christmas and Easter. The tips of the claws of this species are used in medicine intended to absorb acridities in the stomach and bowels. This species is correctly delineated in the centre of Plate I.

The COMMON LOBSTER, *Cancer gammarus*.

Thorax smooth; short serrated snout; very long antennæ; and between them two shorter ones, bifid; jaws and fangs large, the greater tuberculated, the lesser serrated on the inner edge; four pair of legs; joints in the tail; tail-fins rounded. It inhabits the rocky shores of our island, but chiefly where there is a depth of water.

The lobster was well known to the ancients, and is described by Aristotle. It is found as far as the Hellespont; and is called at Constantinople *liczuda* and *licuda*. Lobsters fear thunder, and are apt to cast their claws on a great clap; it is said that they will do the

same on the firing of a great gun. The habitation of this species is in the clearest water, at the foot of rocks that impend over the sea. This has given opportunity of examining more closely into the natural history of the animal, than of many others who live in an element that prohibits most of the human researches, and limits the enquiries of the most inquisitive. Some lobsters are taken by hand; but the greater quantity in *pots*, a sort of trap formed of twigs, and baited with garbage; they are formed like a wire mouse-trap, so that when the lobster gets in there is no return. These are fastened to a cord sunk in the sea, and their place marked by a buoy. They begin to breed in the spring, and continue breeding most part of the summer. They propagate *more humano*, and are extremely prolific. Dr. Baister says he counted 12,444 eggs under the tail, besides those that remained in the body unprotruded. They deposit those eggs in the sand, where they are soon hatched.

Lobsters change their shell annually. Previous to their putting off their old one, they appear sick, languid, and restless. They acquire a new coat in a few days; but, during the time that they remain defenceless, they seek some very lonely and secure place, for fear of being devoured by such of their brethren as are not in the same situation. They are very voracious animals, and feed on sea-weeds, garbage, and all sorts of dead bodies. The pincers of one of the lobster's large claws are furnished with knobs, and those of the other are always serrated. With the former it keeps firm hold of the stalks of submarine plants, and with the latter it cuts and minces its food very dexterously. The knobbed or *numb* claw, as the fishermen call it, is sometimes on the right and sometimes on the left side. The female lobster does not cast her shell the same year that she deposits her ova. When the ova first appear externally, they are small, and extremely black; but they become almost as large

large as ripe elder-berries before they are deposited, and turn of a dark brown colour towards the end of the time of her depositing them. They continue full, and depositing the ova in constant succession, as long as any of that black substance can be found in their body, which, when boiled, turns of a beautiful red colour, and is called the *coral*. Hen-lobsters are found in berry at all times of the year, but chiefly in winter. It is a common mistake, that a berried lobster is always in perfection for the table: when her berries appear large and brownish, she will always be found exhausted, watery, and poor. Though the ova be cast at all times of the year, they seem only to come to life during the warm summer-months of July and August. Great numbers of them may be found, under the appearance of tadpoles, swimming about the little pools left by the tides among the rocks, and many also under their proper form from half an inch to four inches in length. In casting their shells, it is hard to conceive how the lobsters are able to draw the flesh of their large claws out, leaving the shells entire and attached to the shell of their body, in which state they are constantly found. The new shell is quite membranaceous at first, but hardens by degrees. Lobsters only grow in size while their shells are in a soft state. They are chosen for the table, by their being heavy in proportion to their size; and by the hardness of their shells on their sides, which, when in perfection, will not yield to moderate pressure. When barnacles and other small fish are found adhering to them, it is reckoned a sign of superior goodness. Cock-lobsters are in general better than the hens in winter; they are distinguished by the narrowness of their tails, and by their having a strong spine upon the centre of each of the transverse processes beneath the tail, which support the four middle plates of their tails. The flesh of a lobster's claw is more tender, delicate, and easy of digestion, than that of the tail.

In summer, the lobsters are found near the shore, and thence to about six fathoms water; in winter, they are seldom taken in less than twelve or fifteen fathoms. They are much more active and alert in warm weather than in cold. In the water, they can run nimbly upon their legs or small claws; and if alarmed can spring, tail foremost, to a surprising distance, as swift as a bird can fly. The fishermen can see them pass about thirty feet; and, by the swiftness of their motion, suppose they may go much farther. Athenæus remarks this circumstance, and says, that "the incurvated lobsters will spring with the activity of dolphins." Their eyes are raised upon moveable bases, which enables them to see readily every way. When frightened, they will spring from a considerable distance to their hold in the rock, and, what is not less surprising than true, will throw themselves into their hold in that manner through an entrance barely sufficient for their bodies to pass. See the figure of the common lobster at the bottom of the annexed engraving, Cancer Plate I.

The SOLDIER CRAB, *Cancer Diogenes*.

Specific character, hands smooth, hairy, the left one largest. In this species and the next, the tail is furnished with a hook, by which it secures itself in its lodging. These species are parasitic; and inhabit the empty cavities of turbinated shells, changing their habitation, according to their increase of growth, from the small nerite to the large whelk. Nature denies them the strong covering behind, which it hath given to others of this class, and therefore directs them to take refuge in the deserted cases of other animals. They crawl very fast with the shell on their back; and, at the approach of danger, draw themselves within the shell, and, thrusting out the larger claw, will pinch very hard whatever molests them. This is called the *soldier*, from the idea of its dwelling in a tent; as
the





Chapman's crab

1. The Hermit Crab. 2. The same out of the Shell. 3. Soldier Crab.
4. The same out of the Shell. 5. The Land Crab.

London, Published at the New Theatre, April 22nd 1805, by J. Fisher.

the next is the *hermit*, from retiring into a cell. It is very diverting to observe these animals when they have occasion to change their shell. The little soldier is seen busily parading the shore along that line of pebbles and shells which is formed by the extremest wave, still however dragging its old incommodious habitation at its tail, unwilling to part with one shell, even though a troublesome appendage, till it can find another more convenient. It is seen stopping at one shell, turning it, and passing it by; going on to another, contemplating that for a while, and then slipping its tail from its old habitation to try on the new; this also is found to be inconvenient, and it quickly returns to its old shell again. In this manner it frequently changes, till at last it finds one light, roomy, and commodious; to this it adheres, though the shell be sometimes so large as to hide the body of the animal, claws and all. Yet it is not till after many trials, and many combats also, that the soldier is thus completely equipped; for there is often a contest between two of them for some well-looking favourite shell for which they are rivals. They both endeavour to take possession, they strike with their claws, they bite each other, till the weakest is obliged to yield, by giving up the object of dispute. It is then that the victor immediately takes possession, and parades it in his new conquest three or four times backward and forward upon the strand before his envious antagonist. When this animal is taken, it sends forth a feeble cry, endeavouring to seize the enemy with its nippers; which, if it fastens upon, it will sooner die than quit the grasp. The soldier-crab is shown on the Cancer Plate II. fig. 1. and out of the shell at fig. 2.

The HERMIT CRAB, *Cancer Bernardus*.

Specific character, hands rough or muricate, the right one largest. The hermit-crabs mostly frequent those

those parts of the sea-shores which are covered with shrubs and trees, producing various wild fruits on which they subsist; though they will also feed on the fragments of fish and other animal substances cast on shore. When roasted in the shell; they are esteemed delicate. The hermit-crab, hung in the air, dissolves into a kind of oil, which is said to cure the rheumatism, if rubbed upon the part. See Plate II. fig. 3, for the hermit crab; and fig. 4 for the same out of the shell.

The LAND-CRAB, *Cancer ruricola*.

Thorax smooth, the two last joints of the feet armed with spines. It inhabits the Bahama islands, as well as moist lands between the tropics; and feeds upon vegetables. These animals live not only in a kind of orderly society in their retreats in the mountains, but regularly once a-year march down to the sea-side in a body of some millions at a time. As they multiply in great numbers, they choose the month of April or May to begin their expedition; and then sally out by thousands from the stumps of hollow trees, from the clefts of rocks, and from the holes which they dig for themselves under the surface of the earth. At that time the whole ground is covered with this band of adventurers; there is no setting down one's foot without treading upon them. The sea is their place of destination, and to that they direct their march with right-lined precision. No geometrician could send them to their destined station by a shorter course; they neither turn to the right nor left, whatever obstacles intervene; and, even if they meet with a house, they will attempt to scale the walls to keep the unbroken tenor of their way. But, though this be the general order of their route, they, upon other occasions, are obliged to conform to the face of the country; and, if it is intersected with rivers, they are then seen to wind along the course of the stream. The procession
sets

sets forward from the mountains with the regularity of an army under the guidance of an experienced commander. They are commonly divided into three battalions; of which the first consists of the strongest and boldest males, that, like pioneers, march forward to clear the route and face the greatest dangers. These are often obliged to halt for want of rain, and to go into the most convenient encampment till the weather changes. The main body of the army is composed of females, which never leave the mountains till the rain is set in for some time, and then descend in regular battalia, being formed into columns of fifty paces broad, and three miles deep, and so close that they almost cover the ground. Three or four days after this, the rear-guard follows, a straggling undisciplined tribe, consisting of males and females, but neither so robust nor so vigorous as the former. The night is their chief time of proceeding; but, if it rains by day, they do not fail to profit by the occasion; and they continue to move forward in their slow uniform manner. When the sun shines and is hot upon the surface of the ground, they then make an universal halt, and wait till the cool of the evening. When they are terrified, they march back in a confused disorderly manner, holding up their nippers, with which they sometimes tear off a piece of the skin, and then leave the weapon where they inflicted the wound. They even try to intimidate their enemies; for, they often clatter their nippers together, as if it were to threaten those that come to disturb them. But, though they thus strive to be formidable to man, they are much more so to each other; for they are possessed of one most unsocial property, which is, that if any of them by accident is maimed, in such a manner as to be incapable of proceeding, the rest fall upon and devour it on the spot, and then pursue their journey. When, after a fatiguing march, and escaping a thousand dangers, (for they are sometimes three months in getting
to

to the shore,) they have arrived at their destined port, they prepare to cast their spawn. The pease are as yet within their bodies, and not excluded, as is usual in animals of this kind, under the tail; for the creature waits for the benefit of sea-water to help the delivery. For this purpose the crab has no sooner reached the shore, than it eagerly goes to the edge of the water, and lets the waves wash over its body two or three times. This seems only a preparation for bringing their spawn to maturity; for, without farther delay, they withdraw to seek a lodging upon land; in the mean time the spawn grows larger, is excluded out of the body, and sticks to the barbs under the flap, or more properly the tail. This bunch is seen as big as a hen's egg, and exactly resembling the roes of herrings. In this state of pregnancy they once more seek the shore for the last time; and, shaking off their spawn into the water, leave accident to bring it to maturity. At this time whole shoals of hungry fish are at the shore in expectation of this annual supply; the sea to a great distance seems black with them; and about two-thirds of the crabs' eggs are immediately devoured by these rapacious invaders. The eggs that escape are hatched under the sand; and, soon after, millions at a time of the little crabs are seen quitting the shore, and slowly travelling up to the mountains. The old ones, however, are not so active to return; they have become so feeble and lean, that they can hardly creep along, and their flesh at that time changes its colour. The most of them, therefore, are obliged to continue in the flat parts of the country till they recover, making holes in the earth, which they cover at the mouth with leaves and dirt, so that no air may enter. There they throw off their old shells, which they leave, as it were, quite whole; the place where they opened on the belly being unseen. At that time they are quite naked, and almost without motion for six days together, when they become so fat

fat as to be delicious food. They have then under their stomachs four large white stones, which gradually decrease in proportion as the shell hardens, and, when they come to perfection, are not to be found. It is at that time that the animal is seen slowly making its way back; and all this is most commonly performed in the space of six weeks.

This animal, when possessed of its retreats in the mountains, is impregnable; for, only subsisting upon vegetables, it seldom ventures out; and, its habitation being in the most inaccessible places, it remains for a great part of the season in perfect security. It is only when impelled by the desire of bringing forth its young, and when compelled to descend into the flat country, that it is taken. At that time the natives wait for its descent in eager expectation, and destroy thousands; but, disregarding their bodies, they only seek for that small spawn which lies on each side of the stomach, within the shell, of about the thickness of a man's thumb. They are much more valuable upon their return after they have cast their shell; for, being covered with a skin resembling soft parchment, almost every part except the stomach may be eaten. They are taken in holes by feeling for them with an instrument; they are sought after by night, when on their journey, with flambeaux. The instant the animal perceives itself attacked, it throws itself on its back, and with its claws pinches most terribly whatever it happens to fasten on. But the dexterous crab-catcher takes them by the hinder legs in such a manner, that the nippers cannot touch him, and thus he throws them into his bag. Sometimes also they are caught when they take refuge in the bottoms of holes in rocks by the sea-side, by clapping a stick to the mouth of the hole, which prevents their getting out; and then soon after, the tide coming, enters the hole, and the animal is found, upon its retiring, drowned in its retreat. These crabs are of various

sizes, the largest about six inches wide ; they walk sideways like the sea-crab, and are shaped like it: some are black, some yellow, some red, and others variegated with red, white, and yellow, mixed. Some of these are poisonous, and several people have died of eating of the crabs, particularly of the black kind. the light-coloured are reckoned the best ; and, when full in flesh, are very well tasted. In some of the sugar-islands they are eaten without danger ; and are no small help to the negro slaves, who, on many of these islands, would fare very hard without them. See Plate II. fig. 5.

The PRAWN, *Cancer squilla*.

Specific character, thorax smooth, margin five-toothed ; proboscis serrate above and three-toothed beneath ; hind pair of antennæ trifid. The claws are small, furnished with two fangs ; five joints to the tail ; middle caudal fin subulated, two outermost flat and rounded. It is frequent on our shores among loose stones, and taken on the surface over thirty fathoms depth of water ; cinereous when alive, of a fine red when boiled.

There is a variety, about half the size of the above, which turns white when boiled ; and is sold in London under the name of the *white shrimp*. It is caught on the coast of Kent.

The SHRIMP, *Cancer crangon*.

Specific character, thorax smooth, proboscis short, hands with a single moveable fang ; legs only six. This has long slender feelers, and between them two projecting laminæ ; seven joints in the tail ; the middle caudal fin subulated, the four others rounded and fringed, a spine on the exterior side of each of the outmost. It inhabits the shores of Britain in vast quantities, and is the most delicious of all the genus.

MONOCULUS,

MONOCULUS, THE MONOCULUS.

THIS genus, though called *monoculus*, or one-eyed, includes several species that have two eyes, but then they lie (mostly) very near each other, and are imbedded in the shell of the back; the legs are four, six, or eight, in number, very long, and formed for swimming; body covered with a crust, or shell, divided into segments; antennæ four, two, or none; feelers four, in continual motion when swimming, the hind ones very small and hooked. There are 68 species: by far the major part are very small water-insects, requiring the assistance of a microscope for the investigation of their particular organs: some however are so large as to require no very minute inspection; and one species in particular (if indeed it can be allowed to stand with propriety in the genus) is of a size so gigantic that it is generally considered as the largest of the whole crustaceous tribe. This is the *Monoculus Polyphemus*, of which we shall presently speak.

The FOUR-HORNED MONOCULUS, *M. quadricornis*.

Specific character, eye single; antennæ four; tail straight, bifid, the divisions branched. This minute insect must have frequently met the eyes of every one; since it is not only extremely common in every stagnant water, but sometimes makes its appearance in that of pumps, wells, &c. and is in consequence occasionally observed in water brought to the table. Its size is not greatly superior to that of a common mite, but its shape is oblong or lengthened, and the female is remarkable for the appearance of the ovaria, which are attached, on each side the tail, in such a manner as to resemble bunches of grapes in miniature: on each side the head are two long jointed arms, resembling four very long antennæ: the tail is long and bifid: the general colour of the whole in-

fect is white, but it is sometimes seen of a green, and sometimes of a reddish cast.

The WATER-FLEA, *Monoculus pulex*.

Tail inflected, shell mucronate behind. This, which owes its name to its peculiar starting or springing motion, is an almost universal inhabitant of stagnant waters, appearing sometimes in such vast swarms as to cause an apparent discoloration of the water itself. It is an insect of a highly singular and elegant appearance, exhibiting, when magnified, a beautiful distribution of internal organs. Its general length is about the tenth of an inch, but it is sometimes seen considerably larger: its shape is oval, somewhat truncated in front, and sharply pointed behind. The body is inclosed in a bivalve transparent shell, which, when examined by the microscope, appears finely reticulated. On each side the head is a strong transparent jointed arm, forking into two divisions, and terminating in several setaceous branches: the tail, which is generally inclosed within the shell, is occasionally protruded in the form of a strong curved and pointed process. The eyes of this animal are of a singular construction; they are large in proportion to the insect, placed very near each other, and appear to consist of many separate globules, of a black colour, united under a common skin. In the female insect the ovarium is generally very conspicuous, filling the greater part of the space between the shells, above the branchiæ or side-limbs: the ova are very large in proportion to the animal, and the young hatch before their exclusion from the parent. From late observations it appears that this animal possesses, in an inferior degree, the surprising property of the genus *Aphis*, viz. that of producing a series of already-impregnated descendants.

The MOLUCCA CRAB, *Monoculus Polyphemus*.

Specific character, eyes two, placed on the back; legs seven pair. It inhabits the Indian Ocean; and is the largest insect known, the body sometimes measuring two feet in length and the tail two more. We may therefore very reasonably agree with those who urge that a classification of *crustaceous animals* is much wanted. These enormous *insects* are said to be generally found in pairs, or male and female swimming together. The colour of the whole animal is a yellowish brown: the shell is very convex, rounded in front, and lunated behind, where it joins the lower part of the body: this, which is of the same crustaceous nature, is marked on each side into several spiny incisions. The legs, which are seven on each side, are situated beneath the concavity of the large or rounded part of the shell, and are each terminated by a double claw, those of the lowest pair having some additional processes: the branchiæ or respiratory organs are disposed in the form of several flat, rounded, imbricated, lamellæ, on each side the lower part of the body: the tail, which is straight, triangular, and of the same crustaceous nature with the rest of the shell, is equal in length to the whole body, and gradually tapers to a sharp point. The eyes in this species, instead of being approximated, as required in the Linnæan generic character, are extremely distant from each other, being situated towards the sides of the shell: they are of a semilunar form, and the surface is divided into a great number of minute conical convexities: this part however should be considered only as constituting the cornea or exterior covering of each eye; the organs themselves being, according to the observations of Mr. Petiver, in the Philosophical Transactions, placed on a pedicle beneath each of the above-mentioned semilunar corneæ. Petiver's words are these. "The whole structure of
this

this animal is very remarkable, and particularly his eyes, viz. between the fourth and last pair of claws on each side, reckoning from his mouth, and excluding the small pair there placed, are inserted the rudiments of another pair, or a claw broken off on each side at the second joint or elbow; on these extremities are the eyes, like those of the horns of snails; but under the cover of a thick and opaque shell, Nature in that place has wonderfully contrived a transparent lantern, through which the light is conveyed, whose superficies very exactly resembles the great eyes of our large libellæ or adderbolts, which to the naked eye are plainly perceived to be composed of innumerable globuli: these, like them, are oblong, and guarded by a testaceous supercilium."

ONISCUS, THE ONISCUS.

THIS is a diminutive but harmless tribe of animals; they are distinguished by having fourteen feet, setaceous antennæ, and the body of an oval form, consisting of transverse segments, to the number of seven or more. There are 43 species, some of which are terrestrial, and others aquatic. The sea onisci are larger than those of the fresh water, having ten instead of seven segments, though the number of legs is always the same, by which this genus is distinguished from the next. Their motions in the water are rapid; for besides the feet, they are assisted by lateral threads, which push them forward like the oars of a boat. Among them, copulation endures for several days; when the male seizes his female with his two fore feet, and drags her along with him wherever he directs his course; and nothing can induce him to leave his female till this operose function is discharged. A few days after impregnation, the female discovers a distended belly; on the seventh, the young issue alive from her womb, and swim around with alertness and animation. All this while, the male, it is said, continues

tinues fixed upon his female, not for the purpose of fecundation, but of assisting her to cast her slough; a good office; in which he is not successful till he has exerted the whole of his strength. On her first appearance after leaving her coat, the female is entirely white; her slough, of a deep ash-colour, is left floating upon the surface, and so entire, that you would imagine it to be the real animal. This transformation being completed, the male leaves his female, and unassisted undergoes a similar change.

The SHARP-TAILED ONISCUS, *O. entomon*.

Specific character, tail sharp, antennæ none; three first pair of legs very small, four lower pair large and long. This is the largest of the marine insects of this genus, measuring two inches in length. It is a native of the European seas, and is found about rocks, &c. It is of a strong fabric, the divisions of the upper part being of an almost calcareous nature. This animal is capable of living several days in fresh water.

The ROUND-TAILED ONISCUS, *O. aquaticus*.

Specific character, tail rounded, with a forked style each side; antennæ four; two lower pair of legs bifid, and longer. In this species the lengthening of the legs from the front to the back part is gradual, the difference not being so great nor so sudden as in the preceding species. It is a native of the clearer kind of stagnant waters. In the female the ovary is very distinguishable, in the form of a large inflated valve beneath the body. This species is viviparous, and of a very prolific nature.

The WOODLOUSE, *Oniscus asellus*.

Tail obtuse, with a simple style on each side. A well-known insect, and very common in gardens, fields, &c. being observed in great quantities under the barks of decayed trees, beneath stones in damp situations,

situations, &c. Its general length is about half an inch or rather more, and its colour livid brown; the larger specimens often exhibiting a double series of pale spots down the back. Like the rest of the genus, it preys on the minuter insects.

The MEDICAL WOODLOUSE, *Oniscus armadillo*.

Tail obtuse, entire. An insect of a somewhat larger size than the preceding, of a much darker colour, and of a polished surface: it is equally common with the preceding, and is found in similar situations: when suddenly disturbed or handled, it rolls itself up into a completely globular form, in the manner of the quadruped called Armadillo; frequently remaining in this state for a very considerable length of time, or so long as it is any ways disturbed. Swammerdam relates a ludicrous mistake of a servant maid, who, finding in the garden a great many in this globular state, imagined she had discovered some handsome materials for a necklace, and betook herself to stringing them with great care; but on suddenly perceiving them unfold, was seized with a panic, and ran shrieking into the house. Though considered as of but slight importance in the present practice of physic, these animals once maintained a very respectable station in the materia medica, under the title of *millepedes*; being regarded as aperient, resolvent, &c. &c. They were ordered in cases of jaundice, asthma, and many other disorders, and were either taken living, being swallowed, like pills, in their contracted state, or variously enveloped in syrups and marmalades; but were more generally reduced to a powder, and thus mixed with other ingredients.

SCOLOPENDRA, THE CENTIPEDE.

GENERIC characters, Antennæ setaceous; feelers two, filiform; body depressed; legs numerous; equalling the number of segments of the body on each

each side. This tribe has sometimes obtained the name of *millepes*, from the extraordinary number of feet with which nature has provided some of its species; one kind of the scolopendræ having no less than a hundred and forty-eight on each side; but *millepes* is a name now more commonly applied to the woodlouse, which however has never more than fourteen feet. In general, the feet of the scolopendræ are as numerous as the segments into which their bodies are divided; the number therefore varies in the different species from 12 pair to 148 pair. Of this race there are 13 species, distinguished by their form, size, and colour. Some live beneath the bark of decayed trees, or are found below stones and garden boxes; others inhabit the fresh and salt water, and are remarkable for their quick progressive motion. In the East Indies and America, there are scolopendræ from four to six inches long, and as thick as the finger: when of that bulk, their sting is reckoned as dangerous as that of the scorpion. Some of these animals are said to be without eyes, and to direct their course by means of two feelers that extend beyond the head. It has been asserted, too, that when cut into pieces, each segment, like those of the polypi, is capable of reproducing an entire animal; which has given rise to many cruel experiments. The scolopendræ are oviparous animals; and the young, at their first exclusion, are furnished only with a few feet on each side, acquiring after a certain period the number peculiar to their species.

The FORKED SCOLOPENDRA, *Sc. forficata*.

Specific character, legs fifteen on each side, the last longer than the rest, and turned backward; tail forked. This is a very common insect, and is met with in similar situations with the *Oniscus asellus* and armadillo: it is an animal of swift motion; its colour is a polished chestnut brown, somewhat paler beneath, and its usual length an inch and a half.

situations, &c. Its general length is about half an inch or rather more, and its colour livid brown; the larger specimens often exhibiting a double series of pale spots down the back. Like the rest of the genus, it preys on the minuter insects.

The MEDICAL WOODLOUSE, *Oniscus armadillo*.

Tail obtuse, entire. An insect of a somewhat larger size than the preceding, of a much darker colour, and of a polished surface: it is equally common with the preceding, and is found in similar situations: when suddenly disturbed or handled, it rolls itself up into a completely globular form, in the manner of the quadruped called Armadillo; frequently remaining in this state for a very considerable length of time, or so long as it is any ways disturbed. Swammerdam relates a ludicrous mistake of a servant maid, who, finding in the garden a great many in this globular state, imagined she had discovered some handsome materials for a necklace, and betook herself to stringing them with great care; but on suddenly perceiving them unfold, was seized with a panic, and ran shrieking into the house. Though considered as of but slight importance in the present practice of physic, these animals once maintained a very respectable station in the materia medica, under the title of *millepedes*; being regarded as aperient, resolvent, &c. &c. They were ordered in cases of jaundice, asthma, and many other disorders, and were either taken living, being swallowed, like pills, in their contracted state, or variously enveloped in syrups and marmalades; but were more generally reduced to a powder, and thus mixed with other ingredients.

SCOLOPENDRA, THE CENTIPEDE.

GENERIC characters, Antennæ setaceous; feelers two, filiform; body depressed; legs numerous; equalling the number of segments of the body on each

each side. This tribe has sometimes obtained the name of *millepes*, from the extraordinary number of feet with which nature has provided some of its species; one kind of the scolopendræ having no less than a hundred and forty-eight on each side; but *millepes* is a name now more commonly applied to the woodlouse, which however has never more than fourteen feet. In general, the feet of the scolopendræ are as numerous as the segments into which their bodies are divided; the number therefore varies in the different species from 12 pair to 148 pair. Of this race there are 13 species, distinguished by their form, size, and colour. Some live beneath the bark of decayed trees, or are found below stones and garden boxes; others inhabit the fresh and salt water, and are remarkable for their quick progressive motion. In the East Indies and America, there are scolopendræ from four to six inches long, and as thick as the finger: when of that bulk, their sting is reckoned as dangerous as that of the scorpion. Some of these animals are said to be without eyes, and to direct their course by means of two feelers that extend beyond the head. It has been asserted, too, that when cut into pieces, each segment, like those of the polypi, is capable of reproducing an entire animal; which has given rise to many cruel experiments. The scolopendræ are oviparous animals; and the young, at their first exclusion, are furnished only with a few feet on each side, acquiring after a certain period the number peculiar to their species.

The FORKED SCOLOPENDRA, *Sc. forficata*.

Specific character, legs fifteen on each side, the last longer than the rest, and turned backward; tail forked. This is a very common insect, and is met with in similar situations with the *Oniscus asellus* and armadillo: it is an animal of swift motion; its colour is a polished chesnut brown, somewhat paler beneath, and its usual length an inch and a half.

The BITING SCOLOPENDRA, *Sc. morfitans*.

Legs twenty on each side, eyes eight. A native of many parts of Asia, Africa, and South America. Its length is sometimes not far short of ten inches: its colour is yellowish brown, the legs and under parts of the body being much paler: the head is armed on each side with a very large curved fang, of the same strong or horny nature as those of the *Aranea avicularia*, or great American spider, but placed in a different direction, the two fangs meeting horizontally when in action: these fangs are furnished on the inside, near the tip, with an oblong slit, through which, during the act of wounding, an acrimonious or perhaps poisonous fluid is discharged. The eyes are several in number on each side the head, and are placed in a small oval groupe: the tail is terminated by a pair of processes, which perfectly resemble the rest of the legs, except that they are larger, and have the first joints strongly spined or mucronated on the inside. These horrible insects are said to be chiefly found in woods, but, like the small European species, they are occasionally seen in houses, and are said to be so common in some particular districts, that the inhabitants are obliged to place the feet of their beds in vessels of water, in order to prevent their attacks during the night.

IULUS, THE IULUS.

GENERIC characters, Antennæ moniliform; feelers two, jointed; body subcylindric; legs numerous, twice as many on each side as the segments of the body.

The Iuli are so nearly allied to the Scolopendræ, that in the *Fauna Suecia* of Linnæus both are united in one genus. However, their body, instead of being flattened, as in those insects, is nearly cylindrical; and every joint or segment is furnished with two pair of feet, the number on each side doubling that of

of the segments, whereas in the scolopendræ the number of joints and of feet is, mostly, equal on each side. The eyes of the Iuli are composed of numerous hexagonal convexities, as in the major part of the insect tribe, and the mouth is furnished with a pair of denticulated jaws. These animals, when disturbed, roll themselves up in a flat spiral: their general motion is rather slow and undulatory.

The INDIAN IULUS, *I. Indus*.

Specific character, legs 115 pair, yellow; last segment of the body pointed. Colour ferruginous; and measures six or seven inches in length: it is found in the warmer parts of Asia and America, inhabiting woods and other retired places. The number of legs seems to be a variable character.

The SAND IULUS, *I. fabulosus*.

Legs 120 pair. This is the most common species, being often seen in similar situations with the Onisci and Scolopendræ, and usually measures about an inch and quarter in length: its legs of course must be very thin and close. Colour, polished brownish black, except the legs which are pale or whitish. It is an oviparous animal; and the young, when first hatched, are very small, of a whitish colour, and are furnished only with three pair of legs, which are situated on each side the superior part, or near the head; the remaining pairs not making their appearance till some days after, when about seven on a side become visible: the rest are gradually acquired till the number is complete. So long as this species continues in its young or growing state, it is of a pale colour with a dark red spot on each side of every segment: in this state it may sometimes be found in the soft mould of hollow trees.

OF THE CLASS *VERMES*, OR WORMS.

THAT department of natural history which investigates the orders and genera of WORMS; or that class of organized beings which the ancients distinguished by the name of *imperfect animals*, is called *Helminthology*, from the Greek *ελμινθς*, which signifies an earth-worm, and also a worm of the intestines, and *λογος*, a discourse.

The designation of *imperfect animals* was by no means unaptly applied, since by far the greater number of these creatures are destitute of ears, nose, eyes, and legs. They are all of them more or less flow of motion; some indeed seem fixed for ever to the spot where nature produces them; whilst others move only with the matter to which they are attached. In substance they are mostly soft and gelatinous, and extremely tenacious of life; insomuch that, instead of being killed or destroyed by having their parts cut or broken off, they possess the singular power of reproducing them; in which faculty the polypi, of all their congeners, seem wonderfully to excel. The parts of generation in most of them have as yet escaped detection by the microscope; but it is certain that they are chiefly hermaphrodites, and possess the gift of fecundity in a very eminent degree. The head or anterior part is generally distinguished by *tentacula*, or feelers, which are retractile, and of the nature of the horns of snails. With these they feel and entangle their prey; and with them they convey it to their mouth or orifice; whence they are also called *arms*. In all their characters they are totally different from *insects*, though they are often so denominated by authors; but with manifest impropriety and error. Their organization is less perfect than that of the insect tribes; their members are very differently constructed; nor are they, like them, destined to undergo the different stages of metamorphosis. But, though less known,

known, they equal the insects in number, if they do not even surpass them; for there are few substances, either living or dead, in which vermes are not found to be inhabitants, and are subsisted and nourished within them. "They perforate the clay, (says Linnæus,) to give a passage to springs and water; they penetrate the earth, to fertilise the soil by the admission of air and moisture; they bore through wood, and excavate rock and stone, to promote the wise purposes of an immutable Providence; they are assigned a place even in the dark abyss of the ocean, to illuminate the waters by their phosphoric light, as the stars of heaven do the surrounding atmosphere."

This class of animals has been divided by the French naturalists into four sections: the first containing the naked or bare worms, which in their characters approach the nearest to the caterpillars and larvæ of insects; but without having the smallest relation to them. The second comprehends all those species which have a testaceous covering or shell; the organs of which were little known, till the valuable researches of Mr. Adanson proved that their structure closely resembled that of the naked worms. The third section comprises the numerous class of worms with a crustaceous covering, the structure of which resembles flowers and plants, hence called *animal flowers*; but their organization is very different from that of the two preceding classes. The fourth section contains the polypi, with all those zoophytes whose conformation appears nearly to resemble them; for in *resemblance* chiefly is this classification founded. Its insufficiency, however, induced other naturalists, such as Klein, Lister, d'Argenville, &c. to form systems of their own, but equally incongruous;—till Sir Charles Linnæus, with endowments of mind formed for such a task, favoured the world with the following classification of these humblest of all creatures in the scale of being; which in one chain carries the link of
life

life by an almost imperceptible gradation to the efflorescence of a vegetable; whilst the other extends it as it were to a minute particle of sand; or rather to an invisible point, yet full of animation.

CLASSIFICATION.

WORMS are divided into five Orders, which are subdivided into Genera as under.

Order I. *INTESTINA*, or Intestinal Worms. Simple naked animals without limbs or eyes. Contains the following Genera:

Found within other animals.

- | | | |
|-----------------------|-----|---|
| <i>Ascaris</i> | - - | Body round, tapering each way; head with three vesicles. |
| <i>Trichocephalus</i> | | Body round, tapering towards the tail; head furnished with a proboscis. |
| <i>Uncinaria</i> | - | Body filiform, elastic; head with membranaceous angular lips: tail of the female aciform or needle-shaped, of the male armed with two hooks inclosed in a pellucid vesicle. |
| <i>Filaria</i> | - - | Body entirely filiform. |
| <i>Scolex</i> | - - | Body minute, gelatinous, opaque; head exsertile and retractile, with four pellucid auricles. |
| <i>Ligula</i> | - | Body linear, equal, and long. |
| <i>Linguatula</i> | - | Body depressed, oblong; mouth placed on the fore-part, and surrounded with four passages. |
| <i>Strongylus</i> | - | Body round, long; the fore-part globular and truncate, with a circular aperture fringed at the margin; hind-part of the female pointed, of the male hooded. |
| <i>Echinorhynchus</i> | | Body round; proboscis cylindrical, retractile, and crowned with hooked prickles. |
| <i>Hæruca</i> | - - | Body round; head crowned with prickles. |
| <i>Cucullanus</i> | - | Body pointed behind; the fore-part obtuse, with an orbicular mouth. |
| <i>Caryophyllæus</i> | | Body round, smooth, with a large dilated mouth. |
| <i>Fasciola</i> | - - | Body depressed, ovate, with a terminal and lateral pore. |
| <i>Tænia</i> | - - | Body flat, jointed; head with four orifices for suction. |
| <i>Furia</i> | - - | Body linear and ciliate on each side, with reflected prickles. |

Not

Not inhabiting the bodies of other animals ; and without the lateral pore.

- Gordius - - Body equal, filiform, round, and smooth.
 Hirudo - - Body truncate at each extremity ; head and tail dilated when in motion.

Perforated, with a lateral pore.

- Lumbricus - - Body round, annulate, furnished with minute concealed prickles.
 Sipunculus - - Body round ; mouth cylindrical and narrower than the head.
 Planaria - - Body depressed, with a ventral pore.

Order II. MOLLUSCA, or Gelatinous Worms,
 Simple naked animals, furnished with limbs. Genera the following :

Mouth placed above.

- Actinia - - Body fixed, with a single terminal dilatable aperture, surrounded by tentacula or cirri.
 Clava - - Body fixed, with a single dilatable vertical aperture, surrounded with clavate tentacula.
 Pedicellaria - - Body fixed, and furnished with a rigid peduncle.
 Mammaria - - Body loose, smooth, with a single aperture without cirri.
 Ascidia - - Body fixed, with two apertures, one of which is terminal, the other placed a little beneath.
 Salpa - - Body loose, with two apertures, one at each end.
 Dasyatis - - Body loose, angular, open at each end.

Mouth placed before.

- Pterotrachea - - Body pervious, gelatinous, with a moveable fin at the head or tail.
 Derris - - Body round, tapering, articulate ; feelers two.

Mouth placed before ; body with a lateral perforation.

- Limax - - Feelers four ; vent common with the lateral pore.
 Lapyfia - - Feelers four ; vent placed above the lower extremity.
 Doris - - Feelers two ; vent above the lower extremities.
 Tethys - - Body with two small pores on the left side.

Mouth before ; body surrounded with feelers on the fore part.

- Holothuria - - Feelers or tentacula fleshy.
 Terebella - - Feelers or tentacula capillary.

Mouth.

Mouth before ; body furnished with arms.

- Triton - - Arms twelve, divided; some of them cheliferous.
 Sepia - - Arms eight to ten, beset with suckers.
 Clio - - Arms two, membranaceous, extended like wings.
 Onchidium - Arms two, dilated, placed at the sides of the head.
 Lobaria - - Body above convex, beneath flat, lobate.
 Lernæa - - Arms two or three each side, round, slender; two caudal ovaries.
 Scyllæa - - Arms six, each pair at a distance.

Mouth before ; body furnished with peduncles, or feet.

- Aphrodita - Body oval, furnished with eyes; feelers two; setaceous, annulate.
 Amphitrite - Body proceeding from a tube, and annulate; feelers feathered.
 Spio - - - Body proceeding from a tube, and articulate; feelers two, long, simple; eyes two.
 Nereis - - Body long, creeping, with lateral pencilled peduncles or feet; feelers simple.
 Nais - - - Body long, creeping; peduncles or feet with simple bristles; eyes two.

Mouth placed beneath, and generally central.

- Physophora Body gelatinous, hanging by an air-bubble.
 Medusa - - Body gelatinous, smooth.
 Lucernaria - Body gelatinous, wrinkled, and furnished with arms.
 Asterias - - Body coriaceous, flat, generally radiate, and muricate with papillæ.
 Echinus [- Body crustaceous, and covered with moveable spines.

Order III. TESTACEA, or Testaceous Worms. Mollusca covered with a shell.

Multivalves ; shells with many valves.

- Chiton - - Valves placed in transverse plates down the back
 Lepas - - Valves unequal; body sessile.
 Phloas - - Shell bivalve; with accessory valves at the hinge.

Bivalves ; shell with two valves.

- Mya - - Hinge with generally a broad thick tooth, not let into the opposite valve.

Solen

- Solen - - Shell open at each end; hinge with a single or double subulate reflected tooth, not let into the opposite valve.
- Tellina - - Hinge with the lateral teeth of one valve not let into the other.
- Cardium - - Hinge with remote penetrating lateral teeth.
- Mastra - - Hinge with a complicated triangular middle tooth, and an adjoining hollow.
- Donax - - Hinge with a generally-remote lateral tooth, not let into the opposite valve.
- Venus - - Hinge with generally three approximate divaricate teeth.
- Spondylus - - Hinge with two teeth separated by a small hollow.
- Chama - - Hinge in one shell, with two oblique obtuse teeth.
- Arca - - Hinge with numerous penetrating teeth.
- Ostrea - - Hinge without teeth, but an ovate hollow.
- Anomia - - Hinge without teeth, but generally a linear depression on the rim, the beak of one valve curved over the hinge.
- Mytilus - - Hinge without teeth, with a subulate depression, and generally fixed by a silky beard.
- Pinna - - Hinge without teeth; valves united at one end and open at the other.

Univalves, with a regular spire.

- Argonauta - - Shell with one cell. spiral involute.
- Nautilus - - Shell with many cells, with a hole of communication.
- Conus - - Aperture effuse, longitudinal, without teeth.
- Cypræa - - Aperture effuse, linear, longitudinal, toothed each side.
- Bulla - - Aperture a little contracted, and placed obliquely.
- Voluta - - Aperture effuse; the pillar plaited.
- Buccinum - - Aperture with a small canal leaning to the right.
- Strombus - - Aperture with a small canal leaning to the left.
- Murex - - Aperture with a small straight canal.
- Trochus - - Aperture contracted and somewhat square.
- Turbo - - Aperture contracted and orbicular.
- Helix - - Aperture contracted, lunate on the inner side.
- Nerita - - Aperture contracted and semi-orbicular.
- Haliotis - - Shell with a row of orifices along the surface.

4. *Univalves, without a regular spire.*

- Patella - - Shell conic, the aperture widened like a basin.

- Dentalium - - Shell slender, subulate, open at both ends.
 Serpula - - Shell tubular, mostly serpentine, adhering to other bodies.
 Tereido - - Shell thin, pierced into wood.
 Sabella - - Shell composed of agglutinated grains of sand.

Order IV. ZOOPHYTA, Zoophytes, or Animal Flowers. Composite animals efflorescing like vegetables. Contains 15 Genera.

With a hard calcareous stem.

- Tubipora - - Coral, with cylindrical tubes.
 Madrepora - - Coral, with concave stars.
 Millepora - - Coral, with subulate pores.
 Cellepora - - Coral, with hollow round cells.
 Isis - - Stem stony.

With a softer stem.

- Antipathes - - Stem horny, beset with small spines, and covered with a gelatinous fleshy coat.
 Gorgonia - - Stem horny, and covered with a cellular or vascular coat.
 Alcyonium - - Stem corky.
 Spongia - - Stem stringy, flexible, bibulous.
 Flustra - - Stem covered with minute cellular pores.
 Tubularia - - Stem tubular, filiform.
 Corallina - - Stem with filiform calcareous joints.
 Sertularia - - Stem with filiform fibrous joints.
 Pennatula - - Stem coriaceous, resembling a quill.
 Hydra - - Stem medullous, naked.

ORDER V. INFUSORIA, or Worms in Liquids. Simple microscopic animalcules. Genera fifteen.

With external organs.

- Brachionus - - Body covered with a shell, and ciliate at the tip.
 Vorticella - - Body naked, and ciliate at the tip.
 Trichoda - - Body hairy on one side.
 Cercaria - - Body rounded, and furnished with a tail.
 Leucopra - - Body every where ciliate.

Without external organs, flattened.

- Gonium - - Body angular.
 Colpoda - - Body sinuate.
 Paramecium - - Body oblong.
 Cyclidium - - Body orbicular or ovate.

Without external organs, round.

- Bursaria - - Body hollow like a purse.

Vibrio

Vibrio	- -	Body elongated.
Enchelis	- -	Body cylindraceous.
Bacillaria	- -	Body composed of straight straw-like filaments, varying in position.
Volvox	- -	Body spherical.
Monas	- -	Body a mere point.

ORDER I. INTESTINAL WORMS.

THE denomination, *Vermes Intestinales*, given to this order by Linnæus, is not so happily chosen as might be wished; for on the one hand there are worms peculiar to the liver, lungs, pancreas, kidneys, &c. which are never found in the intestines; and on the other, there are five genera, viz. Gordius, Lumbricus, Hirudo, Sipunculus, and Planaria, that never enter the animal body at all, unless by accident; and which therefore cannot be *intestinal* worms; whence some naturalists have substituted the term *vermes viscerales*. This classification too, from so high an authority, has given countenance to a vulgar error conceived in the earliest of times, and propagated almost to the present day, that worms found in the body are not *inbred*, but are taken into the stomach with raw vegetable food or fruit, or by drinking water, in which some young worms, or their ovula, might happen to be deposited; and hence very grave physicians, as well as the bulk of mankind, have been led to imagine that worms, or the rudiments of them, thus taken in by the mouth, are conveyed to different seats in the animal body, where finding a convenient nidus, favourable warmth, and nourishment, they there live and multiply, until they endanger the life of the animal by their numbers. Hence some insist that sheep, feeding in wet pastures, acquire the rot by swallowing the ovula or eggs of aquatic worms deposited on the grass; whilst others contend that the disease is given by a particular kind of herb, (*Ranunculus flammula*, Linn.) the leaf of which exactly resembles the figure of the fluke or gourd-worm, and

blisters the tongue; therefore husbandmen and graziers are in the habit of examining their pastures in search of this herb, which they call *the rot*; because the rot in sheep has the appearance of blisters or bladders on the liver; and, wherever they find it, they pronounce the pasture to be infected; thus believing a vegetable to be endued with the power of giving life to worms in sheep, just as seriously as some doctors pronounce raw vegetables and unripe fruit to beget worms in the *primæ viæ* of the human subject.

On the continent, but particularly in Germany, this branch of natural history has been for some years past more attentively investigated. Professor Pallas, Werner, Goeze, Müller, Bloch, Schroeder, and others, have taken infinite pains to discover and detect the habitudes and economy of this ambiguous class of animals, in order to ascertain their origin, number, office, and mode of propagation. And with a view to the encouragement of this interesting enquiry, the Royal Society of Copenhagen proposed as a prize question, in 1780, "Whether the seeds of intestinal worms be *innate*; or whether they be communicated from *without*, after birth."

The opinion, that the germ or seed of every intestinal worm must be *innate*, was countenanced by the ancient philosophers, and adopted by subsequent physiologists and physicians; such as Hartsoecker, Valisnieri, Andry, Clericus, and even by Hippocrates; because they were aware of the improbability of such worms being planted in the viscera by any foreign or external agent. And, though they failed of demonstrating the fact by positive proofs from the economy of nature, yet they did not deserve the ridicule cast upon them by some more modern writers on natural history; who, without being able to refute their hypotheses, boldly denied them, and asserted that intestinal worms were communicated by swallowing the young, or the ovula, of the common earth-worm, or
of

of water-worms; and that other visceral worms were derived from the atmosphere, by inhaling the animalcules floating in the air, which, finding warmth and nourishment in the region of the respirable organs, would put on a new form, increase in bulk, and perhaps, like insects, undergo various metamorphoses, until the lungs, the liver, and parts subservient to sound health, become impaired by them; and hence the various diseases occasioned by worms in men and animals.

The insufficiency of this conclusion induced the physiologists of the eighteenth century to search more deeply for the habitations of these parasitical tribes; for which purpose a number of different animals were dissected; and the human fabric, whenever opportunity occurred, was diligently examined for the detection of them; while the enquiry and information were most happily facilitated by the improved magnifying powers of the microscope. Pallas was the first who, in his *Diff. de Insectis*, &c. attracted the public attention to this subject, by some very important experiments and observations, tending to prove that these worms were a distinct order of beings, different from every other kind, and capable of being arranged under genera and species of their own, in the same manner that other classes of animals are.

Goeze and Muller followed up these observations with equal ardour and success; and enriched them with a still greater number of elegant dissections; all of which were published and illustrated by engravings; whereby the structure and organization of the intestinal worms are contrasted with those destined to live in earth and water, as well as with those of the *Infusoria* order of animalcules; from all which, very cogent reasons are assigned why intestinal worms could never be communicated *from without*. Goeze, indeed, admits that tadpoles, the larvæ of frogs, of lizards, &c. and the *Gordius aquaticus*, or hair-worm, and even the

the common earth-worm, have sometimes been received into the stomach by drinking impure water, and have occasioned very singular symptoms before they could be thrown off, or evacuated by stool; but here the evil of all such accidental visitants ends. He denies that the *Lumbricus terrestris*, or earth-worm, is ever found as an inhabitant in the human subject, though insisted upon by so many medical men. Neither are the bots in horses, nor any of the oestri genus, nor larvæ deposited in the cuticle, to be considered at all as worms; for they are perfect insects. See OESTRUS, p. 390.

It has likewise been proved, that worms which enter the stomach of animals *from without*, instead of finding a nidus in the viscera, are soon dissolved and digested, unless immediately brought up by an emetic; in which case they are returned generally alive, though in a languid state. But whenever they pass the pylorus, and are evacuated by stool, if any of them are found, or parts of them not sufficiently macerated, it argues a weakness in the powers of digestion, rather than any ability in those animals to maintain their existence in a region for which they were never formed. In dissecting the stomach of frogs, Goeze not unfrequently met with bundles of the *Gordius aquaticus* under different stages of digestion; from which it appeared that the frogs had devoured them as food, instead of affording them an asylum for life, and growth, and nourishment, in their intestines. And just so it is that intestinal worms cannot survive their expulsion from the viscera; nor can a single instance be adduced of either ascarides, tæniæ, fasciolæ, echinorhynchi, or other worms inhabiting the animal body, ever having been discovered in a living state, in any substance or matter whatsoever, *out of the body*. It is indeed true that Dr. Unzer, of Helme-stadt, found a tape-worm in a well; and that parcels of them were also discovered in a small rivulet; the
mystery

mystery of which was soon unravelled by the vigilance of Müller; for on an application to Dr. Unzer and some other persons, and after an examination of the worms, he found that the one had been voided by a child and thrown into the well; and that the others had been thrown off by a numerous breed of carp, which are extremely subject to them; and thus the fact was ascertained; but the worms were dead in the water, a proof that they could not live out of the region from which they had been excluded. Many experiments have been tried for the purpose of endeavouring to keep intestinal worms alive, after being taken from the body; but no medium has yet been discovered in which they could exist for any length of time. Warm water, gravy, blood, and milk, have been tried to little purpose. In asses-milk, warm from the animal, they are found to sustain life and motion by far the longest; and those taken out of fish will live much longer than those taken out of man or any warm-blooded animal; the reason of which is easily accounted for from the cold temperature of the blood of fish, which renders their worms more tenacious of life in the temperature of the atmosphere.

From the great number of intestinal worms found in almost every kind of fish, particularly tape-worms, it has been suggested that this singular species might, by eating fish, be transferred to the human intestinal canal; and the favourers of this opinion appeal to the well-known fact, that in Holland, Swisserland, and Russia, where fish is almost their daily food, there by far the greatest number of people infested with these worms are found. It has indeed been estimated that in Swisserland every tenth, and in Holland every second, person has tape-worms. But this conclusion would by no means be founded, even if it had not been proved that worms peculiar to one kind of animal cannot exist in the intestines of a different animal; for in Denmark, where prodigious quantities of fish are

are also eaten, scarcely a single person is ever known to be troubled with this worm, and yet their fishes abound with them. The Jews, likewise, in all parts of Europe, eat large quantities of fish; yet Dr. Bloch of Berlin asserts, that after a strict enquiry among different tribes of those people, he was confidently assured that persons afflicted with tape-worms were scarcely ever heard of among the Jewish community. Besides, if it were possible for the fish-worms to be communicated to the animals which feed on fish, then every aquatic bird, and numbers of the mammalia class, who live almost entirely on the finny tribe, would abound with those *specific* worms; but the truth is, that no worms except those peculiar to themselves are ever found in them; so that fish-eaters need not be under any alarm from feasting on that aliment.

To prove that the intestinal worms peculiar to one kind of animal cannot exist in the bowels of a different kind, M. Goeze made the following experiment: To a young cock, in whose intestines the *tænia infundibuliformis* is usually found, at three different times, after an interval of a month, and after the cock had fasted full twelve hours, he gave at once three *tænia serrata*, taken alive on dissection from a cat, and at another time he put down several live *tænia canina*, which the cock picked up and swallowed greedily. At the expiration of four months Goeze killed the cock, and dissected the intestines with great care; but not a trace could he discover of the worms that had been eaten; nor was the *tænia infundibuliformis*, or funnel-shaped tapeworm, peculiar to this bird, found in him. This, with other similar experiments, and the discourse upon them, inserted in M. Goeze's very ingenious treatise, "*der Lingeweidewurmer Thierischer Körper*," gained him one of the prizes from the Copenhagen Royal Society; while the other was as deservedly bestowed on Dr. Bloch of Berlin.

In

It has been intimated by some writers on this curious subject, that though living worms may not, as in the above experiment, escape the trituration of the stomach, yet the ovula or eggs might; and, as the intestinal worms are supposed sometimes to cast their spawn with the fæces, it is not only possible, but probable, that among wild animals, birds of prey, and the countless number of shoals of fishes, the fæces may be, and in fact are, often eaten by one another; so that, whenever the fæces shall happen to be charged with the spawn or eggs of intestinal worms, these, by being very minute, and lodged in a kind of mucus or jelly, would naturally escape trituration; and being thus restored to their native element in the warm intestinal canal, would be there attached to its inner coats, and in due season be hatched and matured in the body of a very different animal from its original parent. But, plausible as this hypothesis might appear, M. Goeze succeeded in disproving it, by showing that he had also given the eggs or ovula of intestinal worms, taken by dissection, to poultry, but without effect; besides that, in dissecting an infinite variety of different animals, from the largest to the smallest, he constantly found the intestinal worms to differ in the whole of them, each individual having a peculiar conformation of its own adapted to that species or kind of animals only from which he extracted it. And Goeze further remarks, that if groups of eggs, taken out of the ovaries of these worms, and instantly swallowed by other animals, cannot be matured or hatched by them, it is impossible that such ovula, cast out upon the cold earth, or into cold water, should ever be quickened into life, after thus losing their fecundity or vivifying power. Besides, many species of these worms are viviparous, such as the *ascaris vermicularis*, many of the *echinorynchi*, *cucullani*, &c. which must therefore exclude their young alive into the mucus, and in this infant state

they

they are often thrown out with the fæces, and devoured by birds of many kinds; "yet, (says Goeze,) I challenge the world to produce me a single instance wherein such worm has been found alive in any creature which has swallowed it, or in any other species of animal besides that to which God and nature has assigned it. But, (continues this writer,) what are we to suppose then becomes of the myriads of eggs deposited by these creatures, and the tape-worm in particular? I conceive that they must serve some other purpose in the economy of nature, besides the main office of propagating their like; as does most certainly the seed of plants; and the spawn of fishes. May they not serve as food for each other, as the spawn of fishes does? If every egg in the herring or cod were to be hatched, the sea would soon be too small to contain the incalculable numbers of these fishes! So, if the ovula or eggs of the tape-worm were all brought into existence, the person whose intestines contained the parent worm, would soon become *all worm*: and hence we cannot but admire and adore the benevolent wisdom of the Creator, in fixing due bounds to the multiplication of his creatures, throughout the various orders of his admirable works."

It is observed by professor Pallas, that from the dissections he had inspected, he was warranted in concluding, that wild beasts are most of all afflicted with worms; but the nibbling or gnawing animals, which are careful in the selection of their food, seldom; and the ruminant animals seldomer still. Among birds, the carnivorous, and those that live near the habitations of men, or that are domesticated, have them most frequently. Among fishes, the voracious, *longest living*, as carp, and all such as swim in shoals, are by far the most afflicted with worms.—Yet M. Goeze, on this passage of Dr. Pallas, remarks, that he himself dissected very considerable numbers of foxes, martens, ferrets, and other *small rapacious animals*, and found

found in them very few worms, when compared with the nibbling and gnawing kind, which pick their food carefully and choicely. The woodcock, he says, and the granivorous birds, are very clean feeders, yet he discovered a number of *tænia* in dissecting the woodcock, and a still greater number in the intestines of a partridge. In lambs, sheep, hares, conies, &c. he found *tænia*, and other worms of various kinds: but in swine, which are by far the foulest feeders, he constantly observed the least number of worms.

To conclude; (says M. Goeze,) since we find families of intestinal worms inhabiting more or less the bodies of all animals which we have hitherto dissected; and since these families seem to resolve themselves into a beautiful arrangement of orders, genera, and species, and are constant in their figure, habits, and economy, in each of those animals to which they belong, it seems to me to be most consonant to reason, as well as most compatible with the ordinations of Providence, to believe, that all intestinal worms have their origin or germ formed in the *fœtus* of every animal which produces them; that their office in the intestines must be primarily to serve some wise and benevolent purposes assigned to them by the Creator, although the discriminating powers of man have not hitherto been able to penetrate them; that their habitation in the body is never injurious, but when other causes predispose to their excessive multiplication, such as morbid affections in the viscera and parts adjacent, or the accumulation of putrescent mucus in the bowels, cedematous tumours, &c. a tendency to all which lies in the constitution, or in the influence of different epidemical complaints, rather than in the effect of worms; since very many people live to the grand climacteric, and even beyond it, and are accompanied with worms to the very last.

In support of this doctrine of Goeze, it may not be

improper to notice, that Dr. Heberden found worms in the intestines of an infant born dead. This Order contains 20 Genera.

ASCARIS, THE INTESTINAL WORM.

GENERIC characters, Body round, elastic, and tapering at each end; three vesicles in the head; tail obtuse; intestines milk-white and pellucid. There are 80 species, of which only two, the *vermicularis* and *lumbricoides*, infest the human body. Ascaris is derived from the Greek verb *ασκω*, to be in motion.

The MAW or THREAD WORM, *A. vermicularis*.

Specific character, head awl-shaped; skin at the sides of the body finely crenate, or wrinkled; length half an inch. These generally exist in the greatest numbers in children; whence it has been inferred, that, by their ceaseless irritating action upon the interior membranes, they promote the peristaltic motion of the intestines, by which the excrements are pressed down and excluded, and the passages of the body kept open; which is so essential to its healthful state. Their proper nidus, according to Dr. Heberden, is in the mucus or slime destined to lubricate the bowels; which slime, he thinks, serves them for food. He further observes, that it is this mucus which preserves them unhurt, though surrounded with many other liquors, the touch of which would be fatal. It is hard to satisfy ourselves by what instinct they find it out in the human body, or by what means they get at it; but it is observable in many other parts of nature, as well as in this, that, where there is a fit soil for the hatching and growth of animals and vegetables, nature has taken sufficient care that their seeds should find the way thither. If the ascarides are taken out of their mucus, and exposed to the open air, they become motionless, and die in a very short time; but in general they are so well defended by the mucus from
the

the immediate action of whatever passes the intestines, that they are rarely incommoded in their nidus, unless they exist in great numbers. From these observations of Dr. Heberden, we may easily perceive why it is so difficult to destroy these animals; and why anthelmintics, though greatly celebrated, are far from always being specifics. As the worms which reside in the cavities of the body are never exposed to the air, by which all other living creatures are invigorated, it is evident, that in themselves they must be the most tender and easily destructible creatures imaginable, and much less will be requisite to kill them than any common insect. "Yet, (says Dr. Heberden,) by being immersed in slime, these worms are the most difficult to kill of any, and are yet the least dangerous of all. They have been known to accompany a person through the whole of a long life, without any reason to suspect that they had hastened its end; and as in this man's case there was no remarkable indigestion, giddiness, pain of the stomach, nor itching of the nose, the usual prognostics of worms, possibly these symptoms, where they have happened to be joined with the ascarides, did not properly belong to them, but arose from some other causes. There is indeed no one sign of these worms, but what in some patients will be wanting." Upon this species Dr. Hooper observes: "It is not, as is the generally-received opinion, hermaphrodite; but the male and female are distinct worms. The male, when exposed to the magnifying power, does not exhibit any of the gyrated apparatus, which, in the female, is decidedly for the purpose of bringing the young to perfection. The stomach and intestinal canal have, apparently, a different arrangement from those of the female, and are the only viscera I have been able to detect. I have searched for the male organs of generation, but have never been fortunate enough to find them. Perhaps they are so very minute as to elude our researches. The female has,

upon

upon its external surface, about the eighth of an inch from the head, a small punctiform aperture through which the young are protruded. When the worm is very much magnified, its internal cavity appears filled with the convoluted apparatus; and I have seen upwards of a hundred of the young escape through the external aperture, all alive, and very vivacious, several hours after the death of the mother, upon making a slight pressure with the finger. This is shown in the annexed engraving of *Ascarides*, at fig. 2.

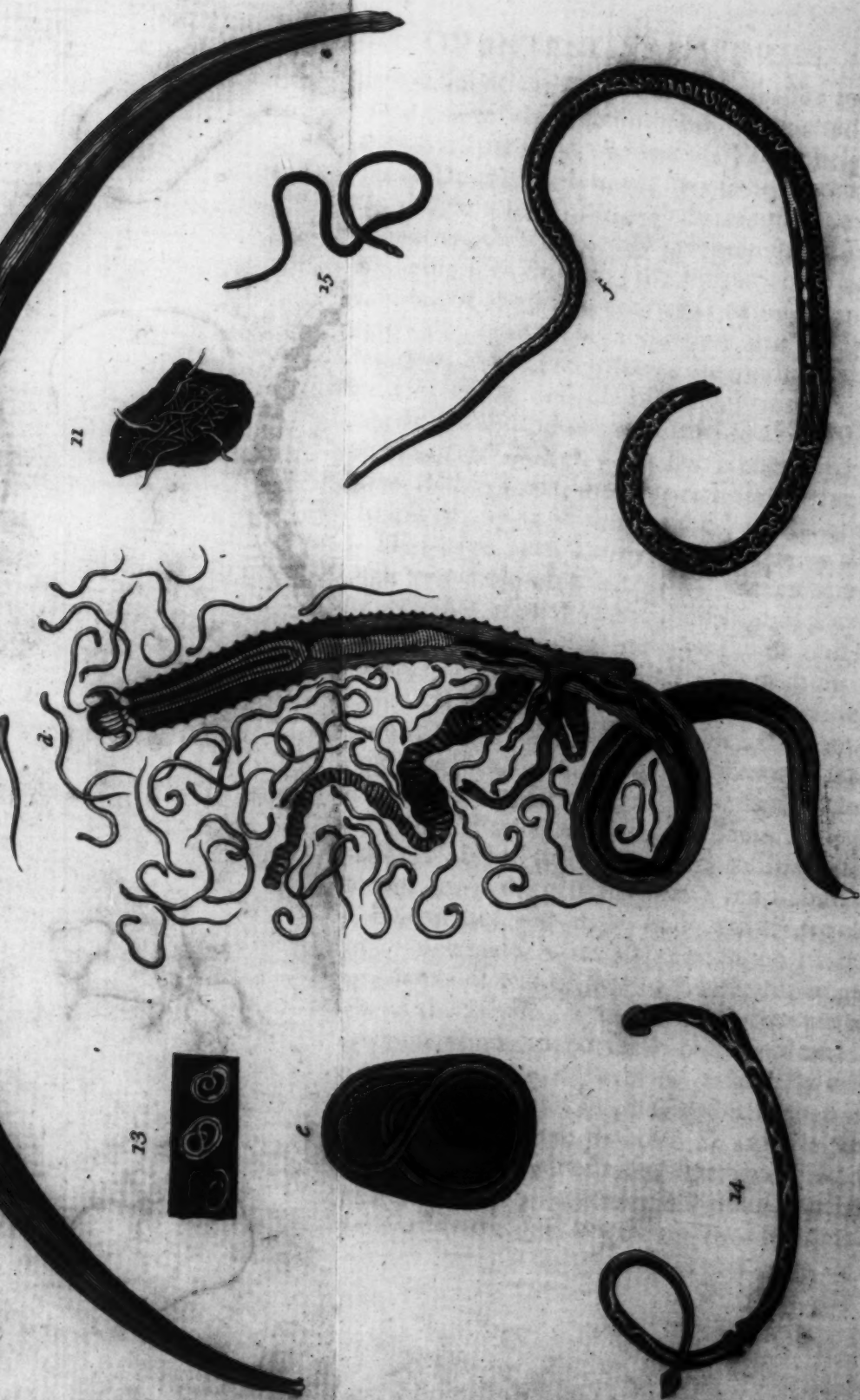
The LARGE MAW-WORM, *A. lumbricoides*.

Specific character, head slightly incurved, with a transverse contraction, mouth triangular. This species is generally about a span in length, but sometimes a foot, or more. "This long round worm of the human intestines, (says Dr. Hooper,) has, for many centuries, been considered of the same species as the earth or lob worm; the fallacy of which I have therefore thought proper to demonstrate. The *Lumbricus terrestris*, or earth-worm, has but one vesicle at its head, in the middle of which is its mouth; it is flattened towards the tail, and is furnished with sharp bristles on its under surface, that serve it for feet, which the animal can erect or depress at pleasure; its annular muscles are very large and strongly marked, and its colour is a dusky red. Whereas the *Ascaris lumbricoides* has none of these phenomena. Its colour is a pale yellow; its muscles very delicate, and its head is furnished with three vesicles instead of one. Upon the under surface of the earth-worm there is a large semilunar fold in the skin, into which the animal can draw its head, or thrust it out at will; but there is no such form in the *Ascaris lumbricoides*; the former also has an elevated belt in its middle, but in the latter there is a depressed band. On each side of the *Ascaris lumbricoides* there is a longitudinal line

very

ASCARIS.





Curious Species of Ascarides.

London. Published as the Act directed by J. Waller.

very distinctly marked; on the earth-worm there are three lines upon its upper surface. The similarity of the generic and specific names has led to the mistake.

Fig. 1. in the same engraving, represents this worm greatly magnified, to show the intestinal canal; *a*, represents a nest of these ascarides in their embryo or egg state; *b*, one of the young just emerged into life; *c*, a bunch of these worms of the size usually voided by children. The *lumbricoides* are often voided in great quantities. Dr. Hooper relates a case of a girl eight years old who voided upwards of 200 in the course of a week. When recently excluded, they are transparent, and appear as if they had been sucking water tinged with blood; this colour, however, soon disappears, and they become of a light opaque yellow. After being evacuated, their motion is feeble, and they soon die. Their motion is serpentine, and in no respect resembles the motion of the *lumbricus terrestris*, or earth-worm, which has the power of diminishing its length and extending itself again, while the length of the *ascaris lumbricoides* is never diminished; the head is always sent forward by the worm curling itself into circles, and suddenly extending it with an elastic force to some distance. They propagate by sexual contact; and the female *lumbricoides* is oviparous, and very prolific.

Other *Ascarides* shown in the same Engraving are—

The *Phoca*: found in the intestines of the Greenland seal; and exhibited at fig. 14, of its natural size.

The *Vituli*. Body filiform: tail rounded: inhabits the lungs and trachea of cattle: is viviparous, and generally gregarious. This is shown at fig. 4, of its natural size.

The *Equi*. Body cylindrical, very large: inhabits the intestines of the horse, and is often discharged with the dung. It is the largest of the genus, measuring often a foot and a half long, and is as thick as a man's little

little finger : body elastic, with frequently large brown patches. This is correctly delineated at fig. 3.

The *Papillofa*. Body papillous beneath : tail ending in a prickly bristle : found in the intestines of the bustard ; about eight lines long, and not thicker than a horse-hair. Fig. 7. represents the papillofa a little magnified ; *d*, the same greatly magnified, and dissected, to show the curious construction of the ovarium, and its innumerable young issuing from it.

The *Galli*. Head hooked ; tail ending in a point : found in the intestines of cocks and hens. Fig. 9 exhibits this a little magnified.

The *Columbae*. Found in the intestines of the house-pigeon. This is delineated at fig. 8 in the engraving, magnified.

The *Pulmonalis* : inhabits the lungs of the toad ; viviparous. Fig. 11 represents a cluster of these minute ascarides, as found by professor Goeze, on opening a toad.

The *Ranae*. Tail subulate : intestines clavate : found in the rectum of frogs. This is shown at fig. 10 in the engraving.

The *Halecis*. Body filiform, spiral, and twisted : found in the seminal vessels and intestines of the heron. Three of these ascarides are exhibited, at fig. 13, precisely as they appeared on opening the fish : *e*, the middle one greatly magnified.

The *Gobionis*. Body extremely slender : tail truncate : found about the liver of the gudgeon. This is represented in the engraving, at fig. 12, a little magnified.

The *Lophii*. Body glabrous, and pale brown : intestines filiform, with variously-twisted milk-white vessels : found in the gullet of the frog-fish. This is shown of its natural size, at fig. 15 ; *f*, the same magnified, to show the convolutions of its intestines.

TRICHOCEPHALUS, THE BLUNT-HEAD.

GENERIC characters, Body round, and curiously twisted; the head or fore-part much the thickest, and furnished with a slender exsertile proboscis, which the animal has the power of thrusting out and drawing in at pleasure. About two-thirds of this worm consists of its tail, which is capillary, and tapering to a fine point; on which account the French call it *le ver à queue*.

The HUMAN TRICHOCEPHALUS, *Tr. hominis*.

This is the *Trichuris vulgaris* of Dr. Hooper. It inhabits the intestines of the human race; but is not often found amongst the people of England. In Germany it is very common; and, according to Blumenbach, oppresses sickly children with their numbers, occupying the intestinum rectum, the inferior part of the ileum, and also the jejunum. They are usually about two inches long; but that delineated in the Helminthology Plate II. at fig. 21, as given by M. Goeze, is very considerably magnified, in order to show its crenated conformation, proboscis, &c. The stomach and intestines consist of a long greenish canal, which is continued in a straight tube from head to tail, where it terminates in the anus. The convoluted or zigzag viscus is the ovarium, found to contain a limpid fluid, the accompaniment of the ovula.

Besides the *hominis*, there are five other species of this worm, found in the intestines of the horse, boar, fox, mice, and lizards.

FILARIA, THE THREAD-WORM.

GENERIC characters, Body round, filiform, equal, and quite smooth; mouth dilated, with a roundish concave lip. There are 18 species; but they are very improperly called intestinal worms, as they are never found in the inside of animals, but form a lodgement

in the cellular membranes under the cuticle, or scarf-skin. The most remarkable species is

The GUINEA-WORM, *Filaria Medinenfis*.

It inhabits both Indies, where it is called *dracunculus*, from the Greek *δρακων*, a serpent; the Arabians called it *Medinenfis*, from the frequency of its appearance at Medina. It is the *Gordius Medinenfis* of Linnæus, but has been removed to this genus by Gmelin. This worm is frequent in the morning dew, from whence it insinuates itself under the cuticle of the naked feet of the slaves, and creates the most troublesome itchings, sometimes accompanied with inflammation and fever: it must be cautiously drawn out by means of a piece of silk tied round its head; for if, by being too much strained, the animal should break, the part remaining under the skin grows with redoubled vigour, and occasions often a fatal inflammation. It is frequently twelve feet long, though not much thicker than a horse-hair.

The LARVA THREAD-WORM, *F. lepidopterorum*.

Specific character, tail hooked. There are eleven varieties of this insect, which infest the larva of the following insects: viz. 1. Body white; found in the *papilio polychlorus*. 2. Body yellowish-grey; found in the *papilio urtica*. 3. Body white; found in the *papilio betulæ*. 4. Body white; found in the *papilio quercus*. 5. Found in the *sphinx euphorbiæ*. 6. Body white; found in the *phalæna quercus*. 7. Body chestnut; found in the *phalæna caja*. 8. Found in the *phalæna ziczac*. 9. Found in the *phalæna nupta*. This variety is shown in the Helminthology Plate II. fig. 16. 10. Found in the *phalæna psi*. 11. Found in the *phalæna pellionella*.—This dwells under the skin of the larvæ, and is very destructive to them; is sometimes solitary, and from four to seven inches long: body glabrous, hard, tapering both ways, but
more

OF INTESTINAL WORMS. 507

more obtuse on the fore-part, defended as it were with three oblong lips.

UNCINARIA, THE HOOK-WORM.

GENERIC characters, Body filiform, elastic; the fore-part obscurely tuberculate, with membranaceous angular lips: tail of the female ending in a fine point, of the male armed with two cuspidate hooks inclosed in a pellucid vesicle. This genus contains only two species; they are small filiform worms, of the nature of Ascarides, and are found in the larger intestines of the badger and fox.

SCOLEX, THE FISH-WORM.

GENERIC characters, Body gelatinous, variously shaped, broadish on the fore-part and pointed behind; sometimes linear and long, sometimes wrinkled and short, round; flexuous or depressed: head protrusile and retractile. There are only two species.

The SOLE-WORM, *Scolex pleuronectidis*.

Specific character, head with four auricles. This is the most minute of all the intestinal worms, being an animalcule, which, in its contracted state, eludes our observation without the help of the microscope. It is nevertheless a most vivacious little creature, possessing the faculty of assuming a number of different shapes and sizes, sometimes linear and long, and shown in the Helminthology Plate II. fig. 14, greatly magnified; and sometimes wrinkled and short, but always broadest on the fore-part, and pointed behind, as shown at *e*. They have hitherto been found only in the bodies of fishes, such as turbot, sole, plaice, &c. and are contained in a sort of gelatinous bag, in which they appear to the naked eye like so many obscure points, as shown at the Engraving at *f*; but when taken out of the mucous bag, they appear as at *g*.

LIGULA, THE BANDAGE-WORM.

GENERIC characters, Body linear, equal, long; the fore-part obtuse; the hind-part acute, with an impressed dorsal future. There are only two species.

The INTESTINAL BANDAGE-WORM, *L. intestinalis*.

Body clear white, and very narrow. Found in the intestines of the merganser and guillemot: about a foot long, and exactly resembling a piece of tape.

The ABDOMINAL BANDAGE-WORM, *L. abdominalis*.

There are eight varieties, infesting as many different species of fish. They are found principally in the mesentery, emaciating the fish they infest, and making them grow deformed: when they escape from the body, they penetrate through the skin: they are about half a line thick, and from six inches to five feet long.

STRONGYLUS, THE LUMP-WORM.

GENERIC characters, Body round, long, pellucid, glabrous; the fore-part globular, truncate, with a circular aperture fringed at the margin; the hind-part of the female entire and pointed, of the male dilated into loose, distant, pellucid, membranes. There are only two species; one of which infests the stomach of the horse, the other of the sheep.

ECHINORHYNCHUS, THE SCRATCHER.

GENERIC characters, Body round: proboscis cylindrical retractile, and crowned with hooked prickles. There are 48 species. They do not infest the human subject; but are found fixed very firmly to the viscera of various animals, generally the intestines; and often remain on the same spot during the whole life of the animal.

The SWINE-SCRATCHER, *E. gigas*.

Clear white; proboscis sheathed, with numerous rows of hooked prickles: found in the intestines of swine, especially those which have been fattened in sties: is gregarious, and from twelve to eighteen inches long. A cluster of them is shown on the Helminthology Plate II. fig. 17, attached to a piece of intestine dissected off by M. Goeze. The largest variety is that found in the boar, generally a foot and a half long, cylindrical, and of a bluish cast; shown in the engraving at fig. 18. They are armed with many circles of retractile prickles or holders, set round the proboscis, correctly exhibited at *h*, as they appear under the magnifier.

HÆRUCA, THE HÆRUCA.

GENERIC characters, Body round, fore part of the neck double, and surrounded with a row of prickles; it has no proboscis, by which it is distinguished from the preceding genus. There is but one species, which inhabits the intestines of the mouse.

CUCULLANUS, THE HOODED WORM.

GENERIC characters, Body sharp, pointed behind and obtuse before; mouth orbicular, head with a striate hood. There are 7 species; they infest the intestines of many animals; but have never yet been found in man. They are mostly viviparous, spirally convolved, and the head is surrounded with a kind of striate hood. The *lacustris*, commonly found in salmon, is delineated on the Helminthology Plate II. fig. 20, as it appears on a side view imbedded in the liver: another section of the liver is exhibited at *i*, showing the head at rest, in its hood.

CARYOPHYLLÆUS, THE CARYOPHYLLÆUS.

GENERIC characters, Body round, mouth dilated and

and fringed.—Of this there is but one species, which inhabits the intestines of various fresh-water fish of the *Cyprinus* genus, as the carp, tench, bream, &c. The body is clay-colour, and about an inch long.

LINGUATULA, THE TONGUE-WORM.

GENERIC characters, Body depressed, oblong; mouth in front, surrounded with four passages.—Only one species, which inhabits the lungs of the hare.

FASCIOLA, THE GOURD-WORM OR FLUKE.

GENERIC characters, Body flattish; an aperture or pore in the head, and another in the abdomen. Forty-seven species of this worm are now known; they are hermaphrodite and oviparous; and are generally found in the stomach, intestines, or liver, of various animals; one species infests man. The name *Fasciola* is Latin, signifying “a little band or bandage,” which is the shape or appearance of most of the species.

The FLOUNDER, OR SHEEP-WORM, *F. hepatica*.

Specific character, body ovate, sharp before, a white line down the middle, and a spot in the centre. This worm is popularly imagined to be the cause of what is called the rot in sheep. It is about an inch long, broadest in the fore-part, and gradually narrowing to the tail. In form, it bears some resemblance to the seed of the gourd, whence it acquired the trivial name of *gourd-worm*; and its likeness, in miniature, to our common flat-fish, gained it the appellation of *flounder*. Their motion, when taken from a diseased liver, and thrown into warm water, is vigorous and undulating, very similar to that of the above-mentioned fish. The back is somewhat elevated, and of a yellowish colour; but the belly is quite flat, and of a lighter colour. They cannot endure the cold; but if, on being exposed to it, they

OF INTESTINAL WORMS. 511

are deprived of motion, they will quickly revive by being held in the hand, or cast into warm liquor.

The ingenious M. Leeuwenhoek gives the following description of this intestinal worm, when subjected to the microscope : " The skin on the back appears rough and furrowed, and covered with prickles or points, and so transparent, that the intestines may plainly be seen on both sides. The head is of a pointed form, the mouth projecting, open, and of an oval shape, like that of a carp. From the heart arise two vessels spreading over the whole body, with a space between them, extending all down the back ; and between these vessels are many smaller ones, which are so minute that no moisture can be discovered within them. I observed in the larger vessels, three sorts of juices, namely, in some a yellowish-brown, and sometimes a kind of purple ; in others a pale green ; of a glutinous or slimy nature, and yet flowing in the vessels (even after the death of the animal,) towards the heart, if held up by the tail, and back again, upon the head being raised. The excretory duct is in a very unusual place, being on the right side of the body, close under the head, for which reason the intestines are as it were crowded together in a heap. There is a small protuberance at the beginning of the bowels, which I take to be the liver ; and between this and the bowels I find, in all of them which I have examined, an innumerable quantity of oval particles, hundreds of which, taken together, are not equal to the size of a grain of sand. They are of a pale red colour, and I take them to be the spawn or eggs. Notwithstanding my most diligent examination, I never could discover any difference of sex. They may be said to swarm in the livers of rotten sheep ; though this depends on their having had more or less time to propagate. I have taken out of one liver 870 in number, besides many fragments, and exclusive
of

of those which were cut in pieces by the knife in opening the liver: and in another liver I have seen but ten or twelve. I have known sheep to be infested by them even from the womb of the parent, and lambs of a year old and upwards, as well as aged sheep." We must add, that Leeuwenhoek was deceived when he attributed eyes to this intestinal worm. What he took for eyes, are the tubercles analogous to the lateral pores of this order of animals, which seem to be calculated partly for attaching the body in different situations, and partly for the work of generation. On the Helminthology Plate II. at fig. 19, a correct delineation of this worm is given.

THE HOOKED FLUKE, *F. uncinulata*.

Specific character, body armed with two elastic hooks on the hind-part. Inhabits the esculent frog, under the common integuments of the abdomen; in its motion it resembles a leech. This curious species is shown at fig. 15 in the same Plate.

TÆNIA, THE TAPEWORM.

GENERIC characters, Body flat, and composed of numerous articulations: head with four orifices for suction a little below the mouth: mouth terminal, continued by a short tube into two ventral canals, and generally crowned with a double series of retractile hooks or holders. There are 92 species, which feed on the juices of various animals, and are mostly found in the alimentary canal, usually at the upper part of it. They are sometimes found in great numbers, and occasion very distressing ailments. They have the power of reproducing parts which have been broken off, and are therefore removed with considerable difficulty. They are oviparous, and discharge their numerous eggs from the apertures on the joints. There are two divisions: One round or globular, and from the size of

of a grain of sand to the bulk of an orange; these are called *hydatids*; the other long and flat, and much resembling a piece of tape, whence the popular name, *tapeworms*.

I. *Hydatids*. Found in other parts besides the intestines, and furnished with a vesicle behind.

These creatures being of a vesicular form, shaped like small aqueous bladders, and betraying no visible sign of animation, their appearance in the human body has been considered, till very lately, as a particular disease, and placed by Dr. Cullen in the class *tumores*. Every one of these tumours, however, is found to possess an independent state of life, and to be able to detach itself, at certain periods, from most of the situations in which it is found. Its head is furnished with a kind of tube; also with four papillæ, which perform the office of suckers; and a double series of *humuli*, or hooks, to hold them in their place, the acute points of which turn towards the neck, and are so arranged, that in the first series they are larger than in the second. Their colour is a slight red, and their contexture considerably firm. The *papillæ surgentes*, or suckers, are placed round the head in such a manner, that it appears to be divided into four equal parts. Each is possessed of an elevated margin, perforated in the centre, manifestly forming a mouth. From these mouths, four canals take their origin, which pass along the neck and body in parallel lines; but towards the extremity they become so pellucid and evanescent, in the more minute species, as to escape the microscope. Its principal difference from the *tæniæ* properly so called, consists in its membranous vesicular expansion, which externally appears to constitute its whole form, and in which the head is generally concealed. It differs also in its habitation; for it is never found in the intestines, but on the surface of the viscera, on the membranes, and sometimes

enveloped in the fat. In every other respect they are the same; yet it is not surprising that its nature has so long been overlooked, since it is sometimes difficult to discover the head, often the only organic part of its system.

Dr. Tyson first discovered hydatids in the livers of sheep; Bartholine observed them in the livers of goats, and Pyerus in hogs. To Pallas, however, we are indebted for the first correct and connected account of these animals, which he has described and figured in his *Miscellanea Zoologica*. After his publication, Goeze, Batsch, Bloch, and others, have added considerably to the stock of information. They found that hydatids are, in general, superficial; that is, some portion is enveloped in the substance of the liver, for instance, and a part rises above it. Yet this is not an universal rule; for, as they are very numerous, some of them must be wholly concealed. Those which burrow in the fat are entirely covered, and can never change their place. Their size differs according to their age, and the temperament of the animal at whose expence they live. Pallas speaks of some as large as the fist, and others still more bulky. Their figure is infinitely varied, but generally approaches that of a flattened sphere. Their colour is generally yellowish white, or semitransparent, sometimes slightly red, or of an amber colour; their substance is composed of different membranes, conglutinated, and formed of circular fibres, visible by means of a lens; but in many animals, particularly in sheep, they are susceptible of an evident contractile power. Internally, on the part opposite to the head, we observe a disc, somewhat thicker than the membrane, with often a number of fatty tubercles, which are supposed to be eggs. They are filled, though not wholly, with lymph, usually transparent, of an oily salt taste, which becomes cloudy by heat. These vesicles are observed to have a motion of their own, which may be styled peristaltic,

peristaltic, and is often very lively. The head is not always at the termination, but often concealed by the reduplication of its membrane or skin; and from this part the hydatid acts on the viscus in which it lives, and sucks its lymph. The animal is best examined by separating the vesicle, and placing it between two pieces of glass, taking care that they press very gently on the anterior part. The head, in that case, pressed forward by the lymph, projects; and with a lens the suckers and humuli are observable.

Hydatids, in the human race, are found chiefly in the liver, the spleen, the uterus, the ovaria, the kidneys, the placenta, the lungs, and even the muscles. Those in the accumulated fluid of dropsies are supposed to be the cause of the disease; and those in the cerebrum are said to attack the brain, and occasion insanity. In the human viscera they occasion acute pains, either continual or temporary. Their presence may, it is said, be suspected by weakness, emaciation, and oppression at the stomach; but these symptoms are owing to many other causes; and, were the existence of hydatids ascertained, there is, perhaps, no remedy yet ascertained that would reach them. Hydatids of the liver are often found in a cyst of cartilaginous firmness, composed of different laminæ, and thicker in some instances than others. The laminæ are white, and apparently lined with coagulable lymph. A cyst often contains various hydatids, some floating loosely in the fluid, and some attached to its sides; and also of very different sizes, from a pin's head to that of a walnut. The largest are generally found floating in the cavity of the abdomen, when distended by dropsy.

In the inferior animals they appear to be more common than in man. They are found in the livers of hares, especially those which feed in marshy ground. In rats they are very numerous; and in sheep they occasion the vertigo or staggers when on the brain,

and the rot when they burrow in the liver. In the hog they produce the appearance sometimes called measles; and they are found also in the rein-deer, the goat, and the ox. The hydatids of hogs are sometimes found in the substance of the fat, and in the muscles; but they are most commonly lodged under the tongue; and, from inspection of that part, the probability of their existence in the flesh may be ascertained.

The *hydatids of man* are the three following: 1. The *visceral* hydatid; its vesicle is round anteriorly, and pointed posteriorly; it is found in the liver, the spleen, the uterus, and the hydropic sacs, of the human race; and is probably a more frequent cause of dropfy than pathologists have suspected; and there is no doubt, should the fact prove so, but that the free use of ardent spirit will greatly promote the growth and increase of the hydatids, and consequently of the disorder. Their vesicles are often lined with an opaque pulpy coat, but are more usually transparent. When in the ovaria, their most frequent residence, they are said sometimes to occasion a false pregnancy. 2. The *cellular* hydatid is contained in a cartilaginous vesicle, grows very large, and is found in the integuments of the muscles of the human race, similar to that which infests hogs. 3. The *cerebral* hydatid, found on the brain.

A remarkable case of fatality, occasioned by visceral hydatids, is given by Dr. John Hunter, as follows: "A man, forty-six years old, died suddenly, after some complaints of pain and difficulty in passing his urine. On dissection, the bladder was found to be enormously distended, and a large tumour filling the pelvis was discovered between the neck of the bladder and the rectum. This contained much water, and many hydatids of various sizes, from one inch and half in diameter to the size of a pin's head. Other smaller tumours, containing hydatids, lay near the neck

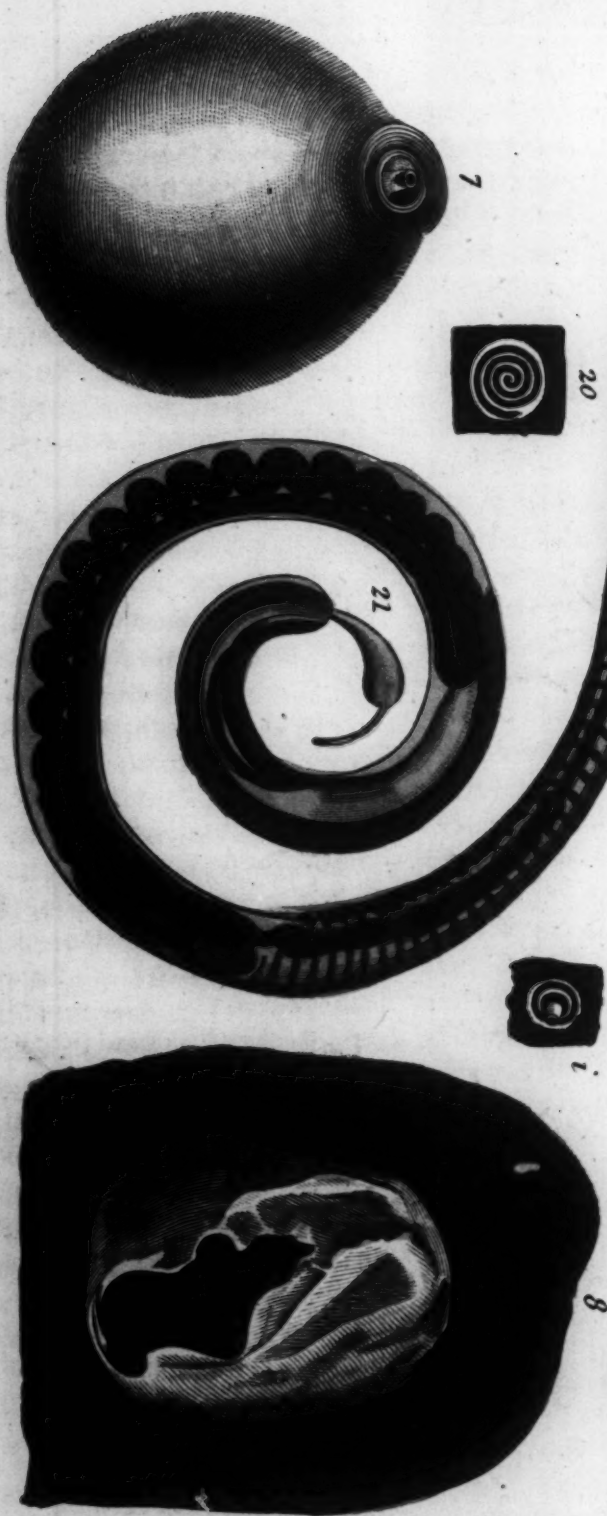
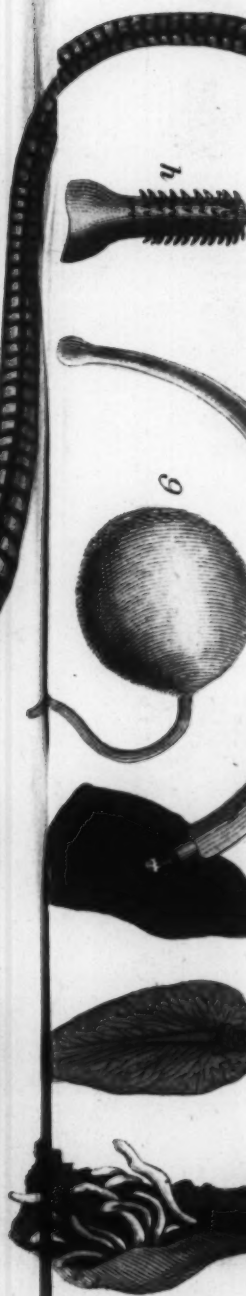
neck of the bladder. A large tumour was also found between the stomach, spleen, and pancreas, and adhering to all three. It was made up of smaller tumours, the contents of which were various; hydatids of different sizes, whole and burst, matter like softened singlass, and clear water, with minute grains. They had all thick coats, double, and endowed with a strong elastic power. All the hydatids had also two transparent contractile coats. Some had small hydatids on their inner surface; and the grains in the water above-mentioned also appeared by the microscope to be minute hydatids.

“ These hydatids, in their growth and decay, appear to pass through various stages; they are first found floating in the fluid that fills the large hydatid, and afterwards attached to its coats. The hydatid thus pregnant with young, if the expression may be allowed, adheres to the neighbouring parts, increases in size, and becomes itself a sac, containing numerous small hydatids. These after a certain time decay, and the skins or empty bags are squeezed together into a substance like isinglass. It is probable that they still undergo a further change; two small bodies, of the size of the common bean, of a cheese-like consistence, and covered with a skin, were taken notice of adhering to the bladder near its neck; it may be a question whether those were not the remains of hydatids; but that must be determined by future observations. It is to be observed, that the young hydatids are found in two very different stages; in the one they are attached to the coats of a hydatid that floats loose in the parent bag or sac; in the other, extremely small globules adhere slightly to the inner surface of a bag or sac, which is firmly attached to the neighbouring parts, and covered with a strong outer coat. It is obvious that the progress of growth is very unequal in those two, and indeed inverted; for in the first the young ones are as large as the heads
of

of pins, while the parent bag is not larger than a walnut, and floats unattached; but on the contrary, in the second there is a large sac with a strong outer coat, and a more tender inner one, adhering strongly to the surrounding parts, while the young ones, that are very slightly attached to its sides, are not of a larger diameter than a $\frac{1}{200}$ part of an inch. Whether these are merely accidental differences in the growth, or depend upon some more essential distinction, must remain to be determined by future observations. However their growth and decay evidently explain the increase and diminution of tumours in the abdomen containing them." In the present case, Dr. Hunter thinks that their origin was probably in the spleen, and that, one of the bags there having burst, they fell by their own gravity into the pelvis, and there adhered and multiplied, till they destroyed the life of the patient; which probably might have been saved by giving them an outlet, or by the introduction of mercury.

Since the discovery of hydatids in the cellular substance, Dr. Adams has endeavoured, with some success, to show that cancer is owing to the introduction of an animal of this kind. If so, its structure must form the septa so often described in such maladies; and the power of reproducing its parts will account for the obstinacy of the cure, and of the growing again, unless the whole scirrhus be clean cut out. Subsequent to this statement by Dr. Adams, a case has occurred of a cancerous testicle, which was extirpated in 1801, and published in the sixth volume of the Medical Journal, p. 194. This cancerous substance contained a hydatid, about the size of a walnut, almost surrounded by transparent spherical vesicular bodies, about the size of small pease, perfectly detached from the adjacent substance, and from each other; and were evidently young hydatids.

In the Helminthology Plate II. at fig. 1, are given,
three

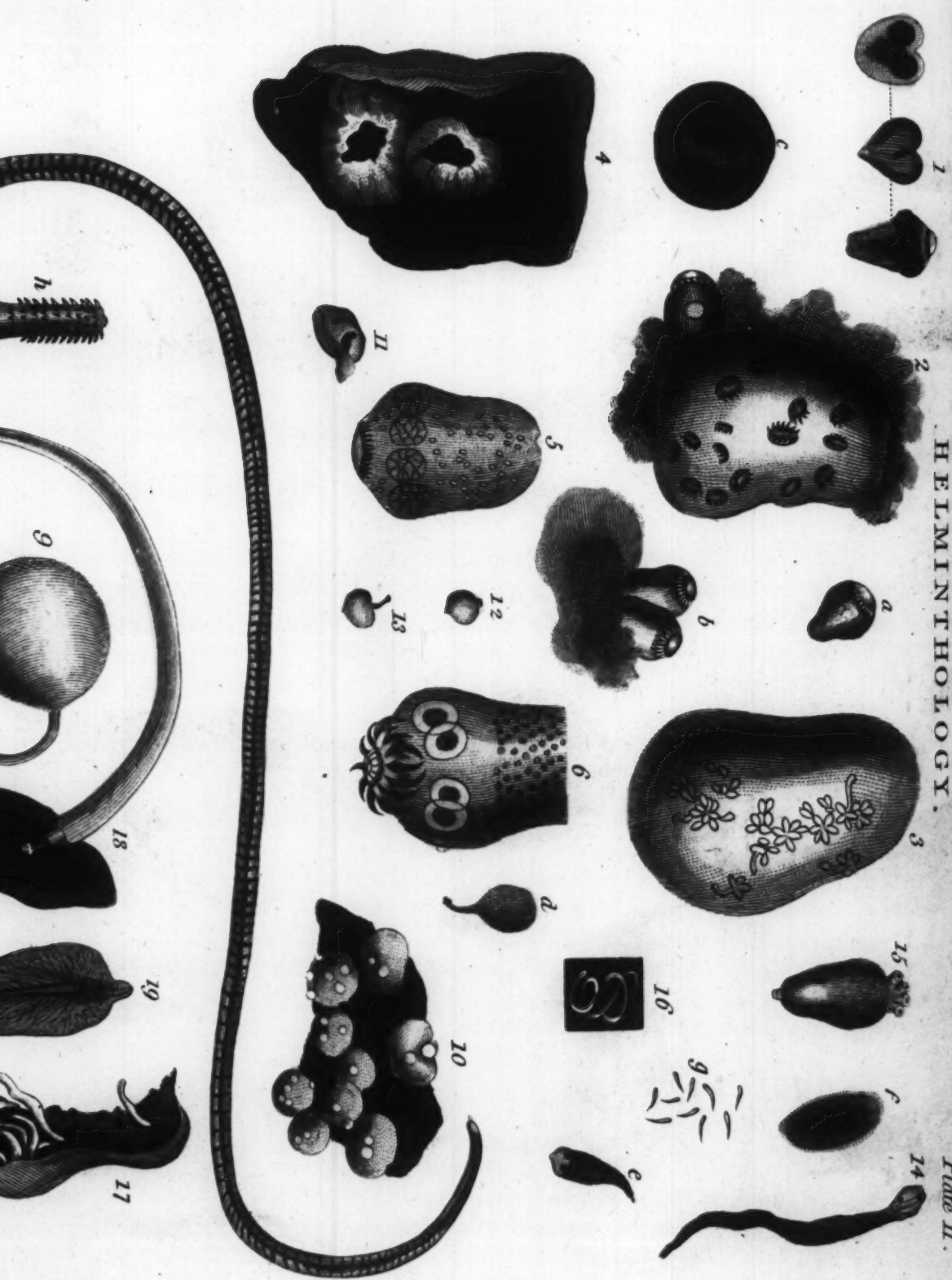


Order of *Nemata Intestinales*. — *Hyptidæ*, *Trichocephalus*, *Sothæ*, &c. Pl. 36

Londæ, Published as the act directs. Feb. 1810. by J. Miller

HELMINTHOLOGY.

Plate II.



three views of the *Tænia visceralis*, or visceral hydatid; the first shows the animal with its head protruded, and the coronet of laciniae or retractile hold-ers exerted; the second exhibits the hydatid in a quiescent state, with its head drawn within the vesicle, broad on the forepart, and pointed behind; the third is a longitudinal section of the vesicle.

Fig. 2, is a very beautiful representation of the *Tænia cerebri-hominis*, as given in the posthumous volume of Goeze's *Eingeweidewurmur*. It was extracted from the brain of a young woman dissected by Professor Meckel of Halle. This patient had been afflicted with violent head-ach, vertigo, and consequent derangement, in which condition she died, after baffling every kind of medical aid. The vesicle was about the size of a walnut, and on that side attached to the brain there appeared to be about fifty young hydatids, with their mouths and laciniae or hooks protruded through the membranaceous coat of the parent vesicle, and from which many of them had the faculty of withdrawing themselves interiorly. May not this curious circumstance serve to throw some light upon the phenomenon of ruptured or decayed hydatids, as noticed above, discovered by Mr. Hunter? May it not, with great probability, be inferred, that these minute hydatids, at a certain period of their growth, pierce the delicate vesicle of the parent, which becomes dead matter in order to forward the escape of its young? These young are scarcely larger than a mustard seed, yet are furnished with a series of hooks, by which they firmly attach themselves to the substance of the brain. In the figure, these hooks are shown magnified, just as they appeared through the coat of the large hydatid; at the lower extremity of which a young one is growing out. At *a*, is shown one of the young taken out of the parent bag; and at *b*, two others. These have been known to grow in a mass to the size of a clenched

clenched fist, until the substance of the brain has been quite absorbed, and the patient said to have died, (in common language,) of a "water-bladder formed upon the brain."

Fig. 3, exhibits the *Tænia cerebialis ovinis*, a hydatid of nearly the same size with the preceding, and with clusters of its young; which prey upon the brain of sheep, and occasion the disease called *staggers*, *duns*, or *ricketts*. In this species, there is a double row of prickles or hooks, amounting to from thirty-two to thirty-six; but in the *hominis* there is only a single row.

Fig. 4, represents two of the *Tænia ovilla*, exactly as they were found in the omentum of a sheep, dissected by M. Goeze.

Fig. 5, the *Tænia granulosa*, found in the liver of a sheep, and occasions the rot, the same as the *fasciola hepatica*, or gourd-worm. These hydatids are from the size of a nut to that of a hen's egg, containing each many thousands of animalcules swimming in the fluid with which it is filled, and are scarcely visible to the naked eye. A mass of these animalcules is figured at *c*. Fig. 6, shows the head of this hydatid, as it appears under the microscope.

Fig. 7, is the *Tænia globosa*, or large hydatid, from the size of a pigeon's egg to that of an orange, found in the abdomen of dropfical people.

Fig. 8, the *Tænia apri*, or hydatid found in the liver of the boar, just as it appeared in a dissection made by M. Goeze. Fig. 9, the *Tænia vervecina*, a hydatid found in the peritoneum of fat sheep.

Fig. 10, a cluster of hydatids, (*Tænia pisiformis*), found on the liver of a hare, dissected by Goeze. At *d*, one of these hydatids is shown detached.

Fig. 11, 12, and 13, exhibit the hydatids, (*Tænia murina*), found in the rat, mouse, and dormouse: these are generally about the size of a pea, but sometimes as large as a hazle nut.

II. Tapeworms.

II. Tapeworms. *Found in the intestines only, and without the terminal vesicle.*

The structure of the tapeworm is extremely curious; but what surprises most is its incredible length. Many have been voided in England from fifteen to thirty feet long; but some are said to measure sixty feet, and Boerhaave expressly mentions his having met with one no less than thirty ells in length. There appear to be three species of this worm incident to man: the *Tænia solium*, said to be endemic in Great Britain, Saxony, and Holland; the *vulgaris*, in Sweden; and the *lata*, in Switzerland and Russia. This singularity, perhaps, may not be strictly founded; but from the observations of different naturalists and physicians, as far as experience can warrant, the fact is generally thus stated. The *solium* derives its name from the supposition, that there never is but *one* of this species inhabiting at the same time in the same individual; whence the French call it *le ver solitaire*. It is however certain that several of them have been voided by the same patient in very short intervals of time, and that they are gregarious.

That these worms should be created for the purpose of producing disease in the animal which they inhabit, is absurd; it would rather seem, (says Mr. Carlisle, Linn. Trans. vol. ii. p. 248,) that nature has not intended any situation to be vacant, where it was possible to multiply the scale of living beings. Perhaps, therefore, a certain proportion of these animals may be conducive to health, just as a certain proportion of different fluids is so; whilst an excessive increase always produces disease. It is however not to be doubted but that worms, and especially the *tænia*, do sometimes produce diseased states of the bodies which they inhabit; though we are also well assured that worms do exist abundantly in many animals without at all disturbing their functions, or giving them

the smallest annoyance. It should also be considered that many states of the animal body are highly favourable to the increase of worms; as droply to that of hydatids, and the rot in sheep to that of the *Fasciola hepatica*, or gourd-worm, as noticed before.

The *Tania solium* is very correctly described by Dr. Hooper, in the fifth volume of the *Mem. Med. Soc. Lond.* 1779, as follows: The head is placed at the smallest extremity of the worm, and united to a chain of articulations more or less broad or long, which gradually enlarge as they advance, and at length terminate in the tail, formed by a rounded joint. Each of these joints contain their proper viscera. When viewed by the naked eye, and lying upon a flat surface, three projections present themselves, one anterior, and the others lateral. But if the head be held up, and its extremity viewed attentively, five projections are conspicuous; one situated directly anteriorly and in the middle, and the other four backwards, and laterally. The anterior projection is the proboscis of the worm. When examined by the aid of glasses, it presents a protuberant margin, surrounding an excavation of a striated appearance like a star. In the centre of this is an orifice or mouth leading to the alimentary canal. The stellated appearance, when more minutely examined and enlarged by the magnifying lens, is found to be composed of two series of radii, with little bulbs or vesicles corresponding to the number of fibrils, with which the margin is beset, and which gives it a lacinated appearance. These *laciniae* are said to be vaginal, including suckorial bulbs, whence they have named them *vaginae sugentes*.

Passing backwards we come to the neck of the proboscis, which, as it advances towards its basis, becomes flattened and broader. Its basis is quadrangular, and has a hollow protruding tubercle or osculum at each angle. It then becomes considerably flattened, and forms a thick margin, which receives the superior

or

or adjacent margin of the next joint. In this species of *tænia* the joints differ very much in the same worm. They are, for the most part, oval, rhomboidal, oblong, or quadrangular, and generally have a great resemblance to large cucumber-seeds. They are shortest near the head, and their length towards the tail is sometimes exceeded by their breadth. When the surface of a joint is viewed by a microscope, directly after it has been wiped with a sponge, it appears rough and villous; but it soon becomes covered with a white tenacious liquid, which exudes through the pores of the skin. If this liquid be again wiped off during the life of the animal, it is quickly renewed. On the margin of each joint, near the middle, is an osculum, and none on the opposite margin of the same joint. It sometimes happens that a joint is furnished with more than one osculum. They have frequently been observed with three or four. But, in general, the next joint has its osculum situated on the margin of the opposite side, so that it alternately changes. This order, however, is seldom preserved throughout the whole tract of the worm, for they are sometimes on the same side for several joints together, but they never are situated on the flattened surface; hence their being *marginal* is an essential character of the *Tænia solium*.—See Helminthology Plate I. fig. 1.

There appears to be but one membrane in the *tænia*, which is very porous and elastic, and which seems, from some experiments, to be endowed with nervous power. *Tæniæ*, therefore, have no cuticle. The head is made up, like the other parts of the worm, of cutis and muscular fibres. The fibres, however, are not in any regular order, but appear to run in every direction, and are united together by a connecting cellular membrane. The head contains also within it the beginning of the alimentary canal, which originates from the mouth by a simple tube

or œsophagus, that bifurcates near the basis of the proboscis. This bifurcated alimentary tube proceeds from the head near each margin of the worm to the other extremity. Through this canal the animal conveys the food to every part for its growth and increase.

When the cutis is removed, the muscles of the worm are laid bare. They are of a white colour, very much resemble the coagulable lymph, and are disposed into two orders, evident to the naked eye.

1. The *longitudinal* or external muscles, which are of a strong firm texture, running parallel to each other in the direction of the worm, being firmly attached to a kind of ligamentous band, and placed along the articulatory receiving margin of each joint. 2. The *transverse* muscles, which are situated under the longitudinal, and across the joint transversely from one extremity to the other. When the longitudinal muscles contract, the length of the joint is diminished and drawn forward. The transverse muscles act by diminishing the breadth of the joint, and sometimes render it almost round. Each articulation, or joint, is furnished internally with two distinct kinds of vessels, the alimentary tube, and the ovaria. The rest of the joint is composed of a connecting cellular substance.

The alimentary canal enters the structure of the head, at the basis of which it divaricates into two distinct tubes, which are continued near the margins from one extremity to the other, and in the extreme joint, where it is impervious, there being no opening analogous to an anus. This longitudinal tube is also supplied with transverse canals. There is always one sent across each joint along the articulatory receiving margin to the canal on the opposite side, with which it has a communication, so that the contents of one tube are, with great facility, communicated across to the other.

Each

Each individual joint has a vascular structure situated between the longitudinal canals, occupying the middle of the worm. It is always disposed in an arborescent form, and is termed the *arborescent ovaria*, from its resemblance to a tree, being composed of a middle canal or trunk, and lateral ramuli; an articulation of which is shown in the engraving at *c*. There is a communication between this arrangement of vessels and the osculum on the margin, by means of an intermediate canal, which, in some joints, is filled with a brown matter. The ovaria are generally filled with an opaque fluid, very like chyle, which is said to contain ovula. In some joints, and mostly those near the tail of the worm (for these are generally more transparent than the rest), this circumstance is evident to the naked eye, especially if the joint be placed on blue paper. If some of this opaque fluid be taken out of the canals and subjected to the microscope, it is said to exhibit ovula of different sizes, from the largest of which very slender *tæniæ* have been seen to escape upon rupturing its ovum, contorted in a spiral form, and having conspicuous traces of articulations, and one extremity acuminate, the other obtusely broad. This experiment was made by Goeze, and is shown in the engraving at *g*.

The joint next to the head is received into the basis of the head, and it, in like manner, receives the beginning of the next joint, which order is observed throughout the whole extent of the worm. Thus the inferior margin of joint, or that towards the tail, is called the receiving articulatory margin, to distinguish it from the other which is received. The receiving articulatory margin is supplied with a ligamentous band, to which the longitudinal muscles are attached, which firmly embraces the next joint. This margin may always be known from the other by its being largest, and by its being fringed, whereas the other is plain, and somewhat rounded.

The

The joints of the *tænia solium* are very easily separated from each other whilst the animal is alive. This separation is effected either by the peristaltic motion of the intestines, or, perhaps, spontaneously. Each joint thus detached from the mother worm, has the power of retaining, for a considerable time, its living principle, and is called, from its resemblance to the seed of the gourd, *vermis cucurbitinus*. This phenomenon has given rise to many warm disputes; several authors have denied their being portions of *tænia*, and have affirmed that they were distinct worms. The separated joints do not appear capable of retaining their situation for any length of time, but are soon forced down the intestinal tube, and at length creep out, or are expelled, *per anum*. "I knew a man, (says Dr. Hooper,) who had been for some time troubled with this species of *tænia*; whenever he took an eccoprotic medicine, he voided upwards of forty detached joints with his *stæces*; and, I remember a female patient, who was always tormented by their creeping *per anum* two or three hours after dining, without the exhibition of any medicine. Such eliminations are common to all who nourish this worm. Thus it is evident that the joints of this animal exist for a time when separated from each other. I have kept them alive for two or three days together; but I do not believe that they are capable of living any length of time in the intestines, when perfectly detached. I am inclined to believe that the *vermes cucurbitini* have not the power of propagating the species, *i. e.* of forming fresh joints; I conceive that property to be peculiar to the head; but this is to be considered as mere hypothesis, cherished by the two following circumstances: 1st. That their expulsion always succeeds their being detached; and, secondly, that the separation of the joints appears to be the only means of insuring the worm a continuance in its sphere; for, were the head to continue multiply-

ing

ing the joints, and the joints have the same power, they would soon obliterate the cavity of the intestinal tube; and, consequently, effect their own expulsion.

“ There are several cases faithfully recorded, and several have come under my own care, where the persons, if their veracity can be depended upon (and they had no interest in deceiving), have voided, during the time they were troubled with the worm, upwards of fifteen thousand. I have attended several patients who were martyrs to the ravages of this animal for upwards of seven years, and the number of joints which during that period have been evacuated, are beyond all conception; from some, upwards of fifty per day, and seldom fewer than twenty. When a specific is administered, and the *whole* worm or worms brought away by stool, no more portions are ever known to follow. But experience teaches, that, when all is voided except the head, then, in a short time after, fresh joints are generated, and the patient is as much troubled with them as before. Thus it is evident that the formation of the joints is proper to the head of the animal, and, I believe, to it alone.”

Mr. Carlisle, in the volume of Linnæan Transactions above referred to, has very judiciously endeavoured to show the probable longevity of the tapeworm, by extracts from an authentic history of a *tænia* preserved in the collection of Mr. Hunter. The data are as follow: Marian Burgoin, a native of Lausanne in Swisserland, at the age of fourteen years, was affected with pains in her stomach and head, rigors, &c. which symptoms continued and were gradually increased. At the age of nineteen she came to England, and was advised to take purging medicines, by which she voided a portion of *tænia lata*, the species endemic in her country. She continued for some years to take drastic purges, and repeatedly voided portions of this *tænia*, which were generally about two yards in length; she voided, at different times,
twelve

twelve of these pieces, but none of them had that extreme joint which is considered to be the head. About eight years after her coming to England, she took the Swisserland medicine, and afterwards the head, together with a large portion of the animal's body, were evacuated; she then perfectly recovered her health. From the foregoing history, it is probable that the head of this *tænia* had existed for the space of twelve or thirteen years; or, if she had voided a head previous to her arrival in this country, we may still suppose the present animal to have lived eight years, because during this last period the circumstances of her case were accurately and attentively preserved.

It is a curious circumstance in the account of this woman, that she felt herself considerably relieved from all her uneasy symptoms after voiding each portion of this *tænia*; but in the course of three weeks they always returned as before, and were not alleviated until she voided another portion. It is therefore almost manifest that the body of the *tænia* was gradually regenerated; after each piece above-mentioned had been broken off; and that the symptoms returned and kept pace with the growth of the worm; its extension along the alimentary canal, and its attachments there, must have proved a source of irritation proportioned to its length.

The editor cannot forbear to mention in this place, the remarkable circumstances of a *tænia* which, for upwards of twenty years, oppressed the health of a person in the Isle of Wight; Mr. Peter Milligan, a bookseller, in the town of Newport. How long it might previously have had a place in the habit, is uncertain; but for the space of twenty years he was confident of the presence of this companion. Being naturally of a robust constitution, and of a tall athletic make, he had long noticed an odd and painful sensation in the region of the stomach, the jejunum, and ileum, without complaint or suspicion of the cause.

cause. With a mind superior to the apprehensions of alarm, he had borne with these occasional pains and disturbances in the bowels for upwards of fifteen years, when, by great accident, he discovered that a piece of tapeworm was voided in his stool. Feeling, however, no disposition to apply for medical advice, as is too often the case with persons of vigorous constitutions, he went on for five years more, occasionally voiding pieces of the worm, and occasionally feeling himself sometimes better and sometimes worse, till his flesh wasted, and his strength and spirits were considerably impaired. The pain in the abdomen was at times so insupportable when standing erect, and so instantly mitigated when lying prostrate, that he had accustomed himself to continue very long in bed, which doubtless facilitated the evident waste of body. In this stage of the complaint, he submitted to a course of medicines, which occasionally brought away pieces of the worm, and partially relieved him; but at length a much stronger anthelmintic was deemed requisite; and, at the expiration of four months from the commencement of the course, it brought away the whole residue of the worm, measuring fifteen feet seven inches. The patient confessed himself wonderfully relieved; but still his health declined. He felt a sensation of coldness and vacancy under the pit of the stomach, which he could never conquer; and from an almost insatiable appetite, he had now no desire for food. He would often jocosely say, "that since he had lost his companion, he should not be able to live himself;" and, continuing still visibly to grow worse, he at length seriously declared this to be his opinion of the cause; and died in 1787, when about sixty years of age; leaving this impression the stronger on the minds of his children and friends, because his death took place in less than eight months after the worm was brought away; and from which time he had declared himself never to have been well.

The colour of *tæniæ* is mostly of a pale yellow or white; but they vary in this respect in different worms. They are not unfrequently of a light brown cast, which, in all probability, arises from living on the chyme, or on chyle mixed with bile. Their motion is undulatory: the first joint towards the head contracts, the succeeding ones follow successively, and the worm is at length drawn considerably forward, exactly in the manner that the earth-worm is seen to move, but not near so rapidly. By this motion the food taken in at the mouth of the worm is very soon conveyed all along the alimentary canal; but can pass no farther, either as food or faeces, for want of the anal orifice; so that these worms might exist many years with very small expence to the chylofactive ducts, even supposing chyle to be their food.

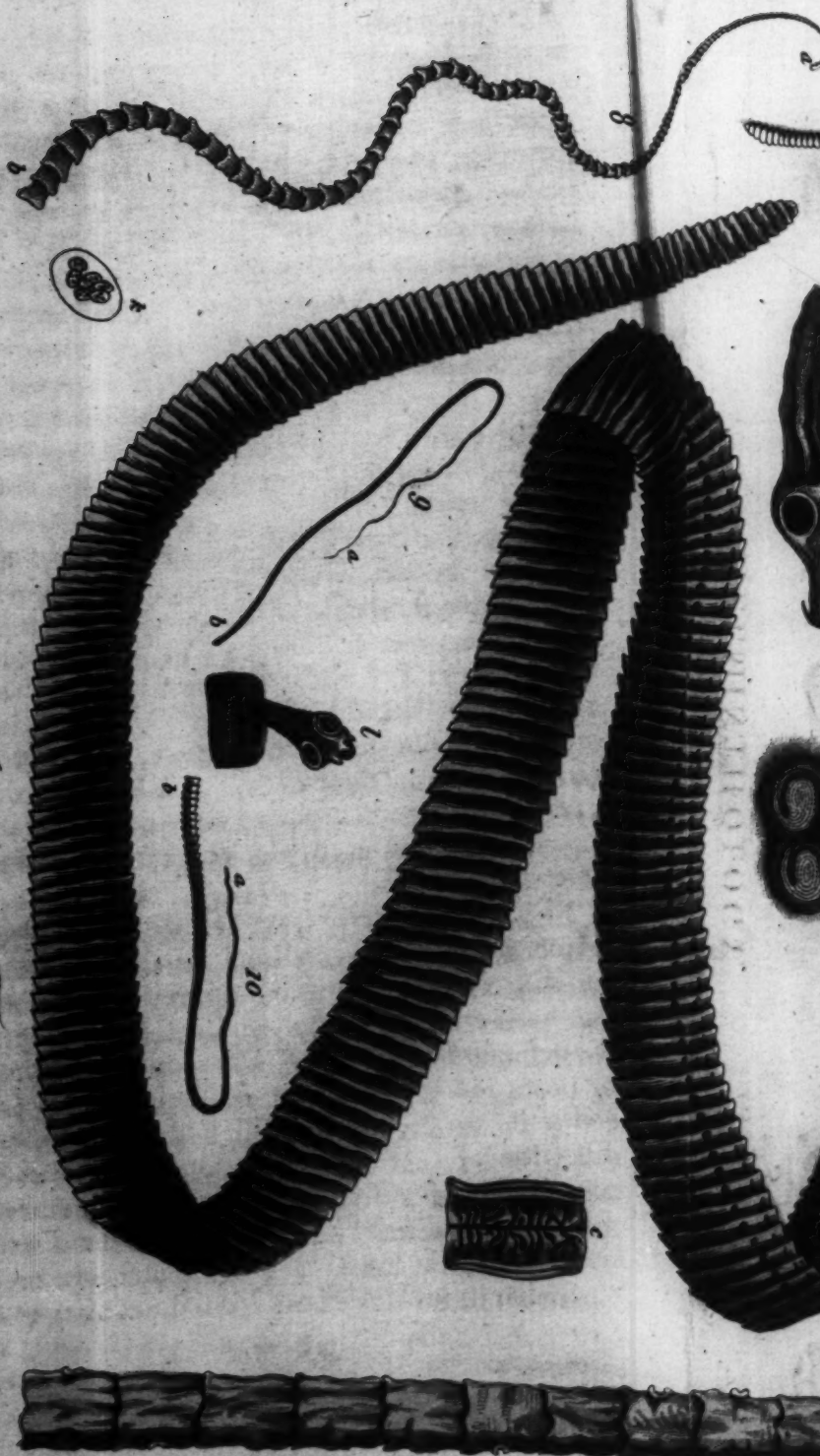
There can be very little doubt of *tænia* being hermaphrodite. The oscula are believed to be viscera, subservient to the propagation of the species, and they have been proved to give exit to the ovula. This is the opinion of Dr. Hooper: and the ingenious Mr. Catliffe, in his paper published in the *Linnean Transactions*, says, "In a *tænia* which I obtained before it was dead, I observed, at one part where it had formed a knot upon itself, that two pairs of these oscula were in contact with each other, and were agglutinated together by a viscid mucus. I was not at that time aware of the possible nature of this connexion, and neglected preserving them in that state. I now suspect, however, that they were in the act of copulation, and that a mutual influence takes place previously to the formation of ova." Vide *Transl.* vol. ii. p. 255.

The Helminthology Plate I. is calculated to show the construction of the Tapeworms. Fig. 1, represents the upper part of the *Tænia solium*, which is endemic in England; the oscula or pores on its sides constitute its specific characters. A portion of the worm

The colour of tæniæ is mostly of a pale yellow or white; but they vary in this respect in different worms. They are not unfrequently of a light brown cast, which, in all probability, arises from living on the chyme, or on chyle mixed with bile. Their motion is undulatory: the first joint towards the head contracts, the succeeding ones follow successively, and the worm is at length drawn considerably forward, exactly in the manner that the earth-worm is seen to move, but not near so rapidly. By this motion the food taken in at the mouth of the worm is very soon conveyed all along the alimentary canal; but can pass no farther, either as food or fæces, for want of the anal orifice; so that these worms might exist many years with very small expence to the chylifactive ducts, even supposing chyle to be their food.

There can be very little doubt of tænia being hermaphrodite. The oscula are believed to be viscera, subservient to the propagation of the species, and they have been proved to give exit to the ovula. This is the opinion of Dr. Hooper: and the ingenious Mr. Carlisle, in his paper published in the Linnean Transactions, says, "In a tænia which I obtained before it was dead, I observed, at one part where it had formed a knot upon itself, that two pairs of these oscula were in contact with each other, and were agglutinated together by a viscid mucus. I was not at that time aware of the possible nature of this connexion, and neglected preserving them in that state. I now suspect, however, that they were in the act of copulation, and that a mutual influence takes place previously to the formation of ova." Vide Transl. vol. ii. p. 255.

The Helminthology Plate I. is calculated to show the construction of the Tapeworms. Fig. 1, represents the upper part of the *Tænia solium*, which is endemic in England; the oscula or pores on its sides constitute its specific characters. A portion of the
worm



Order of Vermes Intestinales. — Tapeworms.

London: Published by the author, 1794.

worm is shown at *c*, with the cutis and muscles removed, in order to exhibit the vascular structure or ramifications of the ovaria, as they appear upon each individual articulation. At *d*, the head or front of the worm is shown greatly magnified, to demonstrate the apparatus of mouth, suckers, and double row of laciniae or hooks, by which the animal holds itself securely in its place at the upper end of the small intestines, where it is supposed to draw its nourishment from the purest or most nutritive of the animal juices. Two distinct portions of ovula or eggs are exhibited at *e*, as taken out of a solium dissected by M. Goeze. This worm is small and narrow at the head-end, increasing in width gradually to the tail, which is its broadest part.

Fig. 2, is a correct delineation of the *Tænia magna*, found in the intestines of the horse: at *f*, the front or head-end is shown, as it appears under the magnifier, with the suckers and hooks with which it adheres to the intestines. At *g*, are shown two of the ovula or eggs, which were opened by O. F. Müller in this dissection, with the young alive, and just ready to burst forth from their cells. It is remarkable that we have no records in the veterinary cases, of horses having suffered any particular ailments from the ravages of this great worm.

Fig. 3, exhibits a specimen of the *Tænia ovina*, which inhabits the intestinal canal of sheep, and is found from eighty to two hundred feet in length: *a*, the head-end; *b*, the tail-end. These are extremely fertile, and are furnished with double marginal oscula or pores for the exclusion of their eggs. The head-end is shown greatly magnified at *h*. This is from a dissection of Goeze; and belongs to that division of *tænia* called *unarmed*, as having no laciniae, or hooks.

Fig. 4, represents the head-end of the *Tænia felis*, found in the cat kind; and fig. 5, exhibits that which is peculiar to the dog; both from dissections of Goeze.

Fig. 6, exhibits a beautiful worm, the *Tænia percae*, found in the sea perch; from a dissection of Muller: *a*, the head-end; *b*, the tail-end.

Fig. 7, furnishes a very curious exhibition of a piece of the intestine of a cock, infested with *Tænia infundibuliformis*; from a dissection of M. Goeze.

Fig. 8, is a magnified specimen of this worm, to show its funnel-shaped articulations; *a*, the head-end; *b*, the tail-end. At *i*, the head is greatly magnified, to exhibit its proboscis armed with very sharp recurved hooks. At *k*, is shown a portion of the ovula of this curious species.

Fig. 9, represents the *Tænia anseris*, a very slender worm, found in the intestines of geese; *a*, the head-end; *b*, the tail-end.

Fig. 10, is the *Tænia lanceolata*, which inhabits the intestines of the duck; *a*, the head-end; *b*, the tail-end. At *l*, the head is shown magnified; having somewhat the appearance of a wart.

FURIA, THE FIEND.

GENERIC characters, Body linear, equal, filiform, and ciliate on each side with a single row of reflected prickles, pressed close to the body. There is only one species at present known, called

The INFERNAL FIEND, *Furia infernalis*.

Inhabits the vast marshy plains of Bothnia and Finland; where it crawls up shrubs and sedge-grass, and, being carried forwards by the wind, penetrates suddenly into such exposed parts of men and horses as are not perpendicularly situated. It quickly insinuates itself under the skin, leaving a black point where it had entered, which is soon succeeded by the most excruciating pain, inflammation, and gangrene of the part, swooning and death. This will sometimes happen in the course of a day or two, frequently within a few hours, unless the worm be immediately extracted, which is effected with great caution and difficulty,

OF INTESTINAL WORMS.

533

difficulty, by applying a poultice of curds or cheese; or carefully dissecting between the muscles where it had entered.

MYXINE, THE HAG.

THIS genus is now removed into the class of FISHES. See vol. xi. p. 458.

GORDIUS, THE HAIRWORM.

THIS worm is named *Gordius* from the Gordian knot; on account of its nimble and numerous contortions. The generic characters are, Body round, filiform, equal, and smooth. There are five species, the most remarkable of which is,

The WATER HAIRWORM, *Gordius aquaticus*.

Specific character, body pale brown with dark extremities. This inhabits stagnant waters, and is mostly from four to six inches long; it twists itself into numerous contortions and knots, and if incautiously handled will inflict a bite at the end of the fingers, and occasion the complaint called a whitlow.

A much larger variety of this species is found on the sea-shores, called *Gordius marinus*, the sea hairworm. Several of these have been taken up on the coast of Devonshire, and an account of them published in the 7th volume of the Linnæan Transactions in 1804, as follows: "They are of so prodigious a length, that it is impossible to fix any bounds; some of the fishermen say thirty yards, but perhaps as many feet is the utmost: those specimens which have come under our inspection did not appear to exceed twenty feet, and more commonly from eight to fourteen or fifteen. If the animal be wounded, or the body divided, small threads of milky appearance issue from the wound, and do not mix with the water without agitation. The expansion and contraction are so unlimited, that it is scarcely possible to ascertain the
utmost

utmost length of this worm : one, which was esteemed to be about eight feet long, was put alive into spirits, and instantly contracted to about one foot, at the same time increasing double the bulk, which originally was about the diameter of a crow-quill. In the vast exertion of the muscles, the animal is generally divided at those parts which had been twined into knots. This worm is very difficult to preserve perfect without contraction; for, if suffered to die in its natural element, one part will decay, while the other is alive; and the addition of any thing offensive produces contraction; even fresh water.

LUMBRICUS, THE EARTHWORM.

GENERIC characters, Body round, annulate, with generally an elevated fleshy belt near the head, mostly rough with minute concealed prickles placed longitudinally, and furnished with a lateral aperture.

The DEW-WORM, *Lumbricus terrestris*.

Specific character, body red, with 8 rows of prickles. It inhabits decayed wood and the common soil, which, by perforating, it renders fit to receive the rain; devours the cotyledons of plants, and wanders about by night; is the food of moles, hedge hogs, and various birds. On the body there are about 140 rings, each of which contains four pair of prickles, not visible to the eye, but discoverable by the touch; when expanded is convex each side, and when contracted is flattish beneath, with a red canal down the whole body,

The LUG, *Lumbricus marinus*.

Back with 2 rows of bristly tubercles. This inhabits shores of Europe, where it buries itself deep in the sand, leaving a little rising with an aperture on the surface; and is used as a bait for fish. Body pale red, round and annulate.

PLANARIA,

PLANARIA, THE FLAT-WORM.

GENERIC characters, Body gelatinous, flattish, with a double ventral pore; mouth terminal. There are 48 species, mostly inhabitants of stagnant waters or marshy places. The species are distributed into five divisions: those of the first division have no eyes that can be discerned; of the second, one eye; of the third, two eyes; of the fourth, three eyes, of the fifth, four eyes; of the sixth, many eyes.

SIPUNCULUS, THE TUBEWORM.

GENERIC characters, Body round and elongated; mouth cylindrical, head narrower than the body; a veruciform aperture at the side of the body. There are but two species; one inhabiting the European seas, the other the American and Indian.

HIRUDO, THE LEECH.

GENERIC characters, Body oblong, truncate at both ends, unarmed, cartilagenous, and moves by dilating the head and tail, and contracting itself into an arch. There are 17 species.

The MEDICINAL LEECH, *Hirudo medicinalis*.

Elongated, olive black, with six yellow-ferruginous lines above, and spotted with yellow beneath. It is found in stagnant ponds and ditches, and is the species used with such success as a phlebotomist in the practice of physic. It is viviparous. The body above is composed of numerous annular wrinkles, which it can contract or expand at pleasure, and marked with variegated lines. Mouth smaller than the tail, and armed with three cartilagenous teeth, with which it draws blood: tail composed of an annular muscle, by which it has the power of fastening its body firmly to any object.

The

The HORSE-LEECH, *Hirudo sanguifuga*.

Elongated, olive-brown, with an ochre-yellow marginal band. This also is found frequently in stagnant waters, ditches, and ponds; it is from four to six inches long. Body above dull olive-black, with an ochre margin each side; beneath paler, with sometimes a few black spots. Tail thicker than the head. This species sucks blood with great avidity and in large quantities.

ORDER II. GELATINOUS WORMS.

IN contemplating this order of Vermes, one is at a loss which most to admire, the beautiful variety of their form—the brilliant transparency of their colours—the splendour of their phosphoric light—or the extensive gradation observable in their size, advancing from the minuteness of a pepper-corn to the unwieldy bulk of an elephant. The elegant formation of many species of the Medusa genus, and the pulsatory motion with which they sail through the water, have been deservedly celebrated by poets, and other writers. The Echinus, for the rich and numerous tints of its coriaceous covering, is scarcely to be equalled by the choicest of the insect tribes; as might likewise be said of some other genera, particularly the Ascidia, Holothuria, Actinia, Amphitrite, and Asterias. The substance of these animals, being mostly soft, and of the nature of jelly, becomes a nutritious as well as plentiful food for fish; as do some of the species for man. This Order contains 32 Genera.

LIMAX, THE SLUG.

GENERIC characters, body oblong, creeping, with a fleshy kind of shield above, and a longitudinal flat disk beneath: aperture on the right side, within the shield: feelers four, situate above the mouth, with
an

OF GELATINOUS WORMS. 537

an eye at the tip of each of the larger ones. The slug is confessedly the most simple as well as most humble of this order of vermes; and, being universally known, affords a ready comprehension of the slimy nature and retractile quality of the flesh of these animals, which can expand or contract at pleasure. There are 15 species.

ONCHIDIUM, THE BENGAL SLUG.

GENERIC characters, Body oblong, creeping, flat beneath: mouth placed before: feelers two, situate above the mouth: arms two, at the sides of the head: vent behind, and placed beneath. There is but one species, named *O. Typha*, because it inhabits the leaves of the *Typha elephantina* at Bengal. It is about an inch long and three-fourths of an inch broad, but linear and longer when creeping. In appearance it very much resembles a *Limax*, but differs principally in wanting the shield and lateral pore, and in being furnished with a vent behind.

LAPLISIA, THE SEA-HARE.

GENERIC characters, Body creeping, covered with reflected membranes, with a membranaceous shield on the back covering the lungs: aperture on the right side: vent above the extremity of the back: feelers four, resembling ears:

There are but two species. 1. *L. depilans*, which inhabits European seas; from two to five inches long: is extremely nauseous and fetid, and is said to cause the hair to fall off the hands of those who touch it. 2. *L. fasciata*, which inhabits the shores of Barbary, among rocks: when touched it discharges a black and red sanies, but not fetid or depilatory like the first species.

DORIS, THE DORIS.

GENERIC characters, Body creeping, oblong,
VOL. XIII. No. 177. 3 Y and

and flat beneath: mouth placed below, on the fore-part; vent behind on the back, and surrounded by a fringe: feelers two or four, seated on the upper part of the body in front, and retractile within their proper receptacles. There are 24 species, inhabitants of the Mediterranean, Atlantic Ocean, Indian and European seas.

THE SEA-LEMON, *Doris argo*.

Specific character, body oval, smooth; feelers two, small. It varies much in size and colour; some being found of a yellow, more or less deep; others of a rich citron, or bright orange; and others again of a dull red, or scarlet. In all these varieties the body is convex, marked with numerous spots or punctures, and the vent surrounded with elegant ramifications.

THE CLAVATE DORIS, *Doris clavigera*.

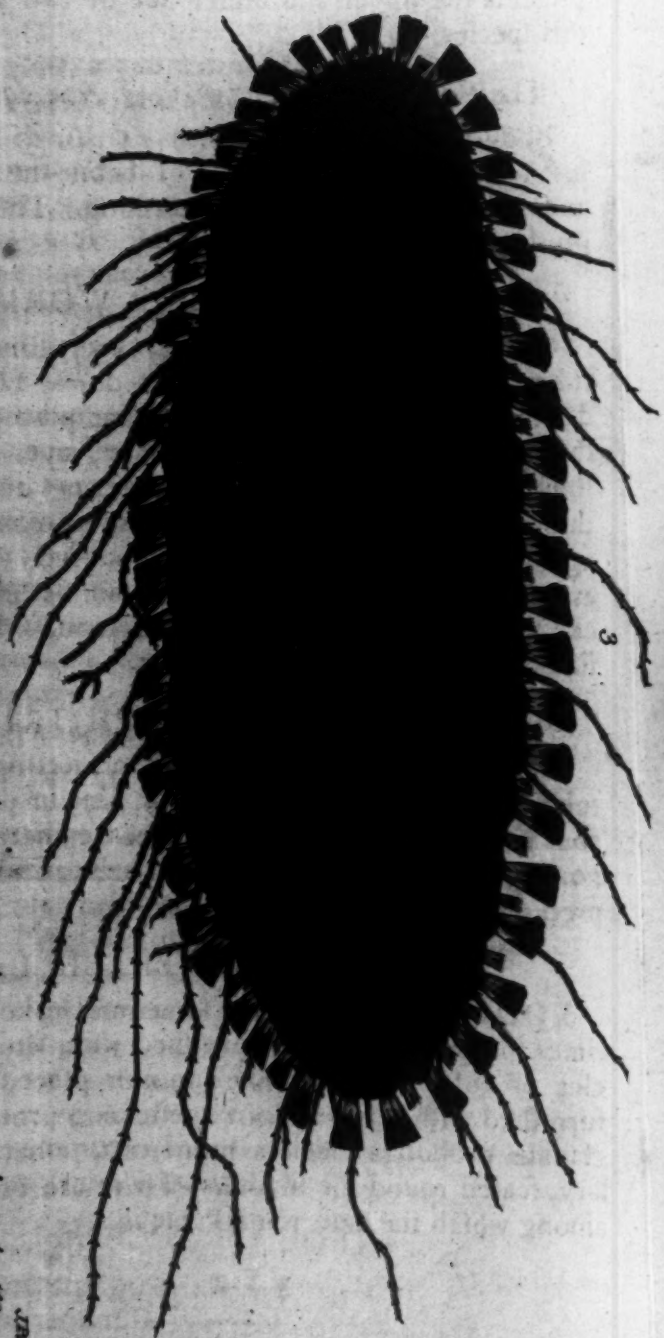
Body oval, white, with saffron-colour clavate pedicels on the back. In the Helminthology Plate III. fig. 4, this worm is shown in its creeping state; and turned on its back at fig. 5.

APHRODITA, THE APHRODITE.

GENERIC characters, Body creeping, oblong, with many small tentacula or protuberances on each side, which serve as so many feet: the mouth is cylindrical at one end of the body, and capable of being retracted, with two bristly tentacula or feelers; eyes four. There are nine species.

THE ACULEATED APHRODITE, *Aph. aculeata*.

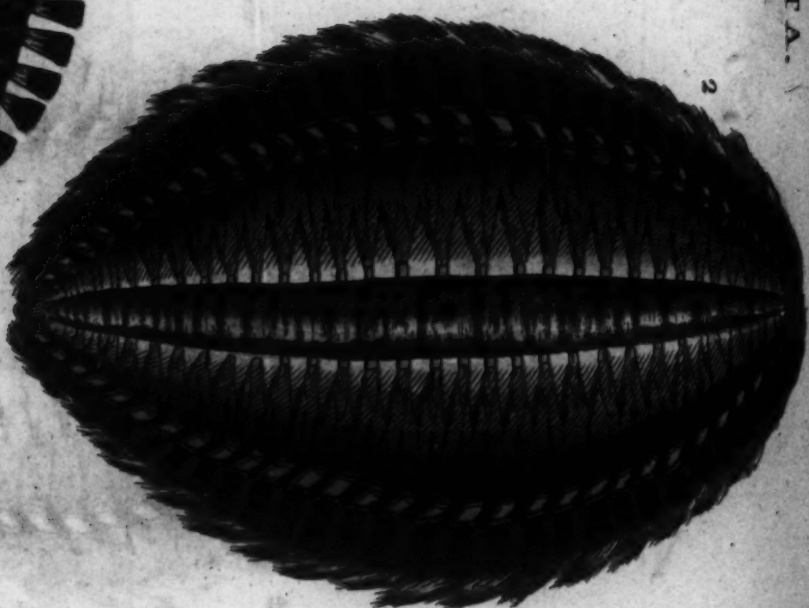
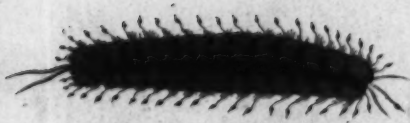
Body oval, brown, beneath flesh-colour, with long silky changeable hair on each side the body. Inhabits the European seas, and is often found in the belly of the cod-fish. It is from four to seven inches in length; the number of feet varies from 30 to 36



Two varieties of the aculeated *Aphrodite*, showing the upper and under parts.
 Fig. 5. the squamate *Aphrodite*.

London: Published as the Author's private property by J. Johnson.

APHRODITA.



OF GELATINOUS WORMS. 539

on each side. The annexed Plate, fig. 1, 2, 3, 4, represents the upper and under side of two varieties of this species.

The SQUAMOSE APHRODITE, *Aph. squamata*.

Body oblong, covered with 24 pair of large yellow scales dotted with black. Inhabits the European and Asiatic seas; about an inch long. This is shown on the same Plate, at fig. 5.

SPIO, THE TUBULAR WORM.

GENERIC characters, Body projecting from a tube, jointed, and furnished with dorsal fibres: peduncles or feet rough with bristles and placed towards the back: feelers two, long simple; eyes two, oblong.—There are two species, differing only in the thickness of the feelers. The tube is composed of agglutinated particles of earth, thin, erect, and thrice as long as the body; from this the animal projects its capillary white feelers in search of food, which consists of small marine worms.

AMPHITRITE, THE AMPHITRITE.

GENERIC characters, Body projecting from a tube and annulate: peduncles or feet small, numerous; feelers two, approximate, feathered; eyes none.—This contains 7 species, in habits similar to the preceding.

TEREBELLA, THE TEREBELLA.

BODY oblong, creeping, sometimes naked, sometimes inclosed in a tube, furnished with lateral fascicles or tufts and branchiæ: mouth placed before, furnished with lips, without teeth, and protruding a clavate proboscis; feelers numerous, ciliate, capillary, seated round the mouth.—There are 11 species, among which the most remarkable is

The SHIP-WORM, *Terebella complanata*.

Specific character, body depressed, with four cirri round the mouth, and a double row of 130 lateral pencilled protuberances on each side. It inhabits seas round the West-India Islands, and is extremely destructive to vessels lying at anchor: it cuts with great facility through the stoutest plank, and burrows into the substance, incrustating the sides of the hole with a smooth testaceous coat: with equal ease and expedition it destroys piles and the timber of wharfs.

NEREIS, THE NEREIS.

BODY long, creeping, with numerous lateral peduncles or feet on each side: feelers simple: sometimes none: eyes two or four, sometimes none. There are 29 species.

The SHINING NEREIS, *N. noctiluca*.

Specific character, body blue-green, with 23 segments; hardly visible to the naked eye. These are found in most seas, and are the animals which frequently illuminate the water, making it appear as if on fire: they are extremely minute, pellucid, and highly phosphoreous, giving an uncommonly lucid splendour to the waves in an evening: by their extreme numbers and smallness they easily elude observation, but may be detected by passing a small quantity of the water through blotting-paper.

NAIS, THE NAIS.

BODY creeping, long, linear, pellucid, depressed: peduncles or feet with small bristles each side: tentacula none; eyes two, or none. There are 10 species; they are small harmless worms, inhabiting stagnant waters, sea-weeds, &c.

ASCIDIA,

Plute and curious species of doctidia.

London, Published as the Act does, July 1784, by J. M. M.

Amesbury.



ASCIDIA



ASCIDIA, THE BOTTLE-WORM.

GENERIC characters, Body fixed, roundish, and apparently issuing from a sheath or pouch: apertures or mouths two, generally placed near the upper end, one beneath the other; sometimes one in the centre at top, and the other lateral. There are 34 species; mostly found in the sea, and adhering by their base to rocks, shells, and other submarine substances: they are more or less gelatinous, and have the power of squirting out the water they take in by their orifices or mouths. Some of them are esculent; most of them sessile, though a few are furnished with a long tubular stem. They alternately contract and dilate themselves, with a similar power to that of the slug and snail. The name Ascidia, is derived from the Greek *ασκος*, a bottle, to which most of the species bear a gross resemblance.

Some of the most rare and curious species of Ascidia are delineated on the annexed Plate: viz.

Ascidia aspera: subcompressed; rough whitish skin; pouch spotted or streaked with red. Inhabits the Norway Seas; represented at fig. 1.

Ascidia rustica: brownish, with red or flesh-colour apertures. Inhabits the European Seas, adhering to shells and sea-weeds; body flat beneath, rounded at top, as represented at fig. 2. In this very rare specimen the young are seen adhering, like tubercles, to a piece of shell, and to the parent animal; the small are yellowish white; the larger red.

Ascidia patula: roundish, yellowish rough skin, with a red pouch: orifices scarlet, one of them lateral: Inhabits the Norway Seas, on rock or fuci. Body pellucid: mouth resembling a flask, as represented in the engraving at fig. 3.

Ascidia parallelogramma: white, convex, hyaline: pouch reticulate, and yellowish: one of the apertures yellowish, the other dark brown. Inhabits Norway, amongst

amongst fuci. Body oblong, nearly square, with obtuse angles, and marked with scarlet lines, as delineated at fig. 4.

Ascidia venosa: subcompressed, torose, red; pouch the same colour. Inhabits the Norway Seas, adhering to fuci like a bunch of fruit, as exhibited at fig. 5.

Ascidia scabra: compressed, pouch red, orifices the same colour; body roughish to the touch; apertures narrow, with a conic neck: outer skin very pellucid, gelatinous, and hardish. Inhabits the Norway Seas, adhering by its side to fuci, as shown in the engraving at fig. 6.

Ascidia canina: elongated, roundish, flaccid, formed in the shape of testes; mouths red; as exemplified in the engraving at fig. 7. It inhabits the Atlantic and Norway Seas. Skin large, glabrous, subpellucid: circumference of the apertures transparent red; pouch reddish yellow, as shown by a longitudinal section of the outer skin at fig. 8: where the animal is exposed in its true shape and form.

SALPA, THE STOCK-WORM.

GENERIC characters, Body loose, formed for swimming, tubular, open at each extremity; intestine placed obliquely. This genus contains 11 species: they are of a gregarious nature, and swim in company with great facility; possessing the power of contracting or opening at pleasure the cavity of their extremities: they are very transparent, and exhibit a rich appearance of varying colours.

DAGYSA, THE DAGYSA.

GENERIC characters, Body loose, formed for swimming; angular, tubular, and open at each extremity. There is but one species; it was discovered by Bankes and Solander, and is described by Dr. Hawkesworth. It so nearly resembles the Salpa, as will be evident on comparing the generic characters, that

OF GELATINOUS WORMS. 543

that the two genera might with great propriety have been incorporated together.

CLAVA, THE CLUBBED WORM.

GENERIC characters, Body fleshy, gregarious, clavate, and fixed by a round peduncle: aperture single and vertical. There is but one species, which is a small fixed animal, with no other motion than what is afforded by its dilatable muscles, which enable it to erect its body; having a vertical mouth at the top, fed by a border of tentacula, which gives it the appearance of a flower.

ACTINIA, THE ACTINIA.

OF this genus of worms, the characters are, that the body is oblong and smooth, attaching itself firmly by its basis to rocks or other solid substances, having a dilatable apex hooked within. The mouth is furnished with crooked teeth, the rostrum cylindrical and radiated. There are 36 species, some of which make a beautiful appearance, and are called animal flowers, sea anemonies, and *urtica marina*. Progressive motion in these creatures is so slow, that it is difficult to perceive any, as they scarcely advance the length of one inch in an hour. They are viviparous, feed on shell-fish, open their mouth more or less according to the size of their prey, and reject the shell through the same aperture. When the mouth is open, all the tentacula of the actinia may be seen, resembling in that situation a full-blown flower, which has given it the denomination of flower-fish, or *animal-flower*, though this last designation is now more peculiarly confined to the Zoophyta, or worms of the fourth order.

MAMMARIA, THE NIPPLE-WORM.

GENERIC characters, Body smooth, without cirri or rays; the aperture single. There are three species:

species: they are very simple, soft, smooth, naked, worms; inhabiting the Northern Ocean and the Greenland Seas.

PEDICELLARIA, THE STALKED WORM.

GENERIC characters, Body soft, and seated on a rigid stiff peduncle; aperture single.

The GLOBULAR PEDICELLARIA, *P. globularia*.

Head spherical, reddish, with the appearance of a small cherry; no neck; peduncle or stem tawny. This is shown on the Helminthology Plate III. fig. 7.

TETHYS, THE TETHYS.

GENERIC characters, Body detached, rather oblong, fleshy, without peduncles: mouth with a terminal cylindrical proboscis, under an expanded membrane or lip: apertures two, on the left side of the neck. There are two species, one inhabiting the Mediterranean, the other the Adriatic, about six inches long.

PTEROTRACHEA, THE FINNED WORM.

BODY detached, gelatinous, with a moveable fin at the abdomen or tail: eyes two, placed within the head. There are four species, one of which, the *coronata*, has both abdomen and tail furnished with fins, the head with a round perpendicular proboscis, and a coronet of 10 spines in the front.

DERRIS, THE DERRIS.

GENERIC characters, Body cylindrical, composed of articulations: mouth terminal: feelers two. —A new genus, instituted for a single species, described in the Transactions of the Linn. Soc. It inhabits the coast of Pembroke-shire. The body is cylindrical, gradually tapering to a point behind, composed of joints, and capable of great flexibility; covered

OF GELATINOUS WORMS. 545

vered with a membranaceous transparent coat, through which the internal parts are visible. The head extends beyond the outer skin, and is less than the anterior part of the body, to which it is connected by a membranaceous covering forming a neck. Feelers white, situated at the top of the head, and capable of being raised or depressed at pleasure. Mouth consisting of two lips, the upper-one hooked and moveable, the lower-one straight and fixed. It moves by an undulatory motion of the whole body.

HOLOTHURIA, THE HOLOTHURIA.

GENERIC characters, Body detached, cylindrical, thick, naked, and open at the extremity: mouth surrounded by fleshy branched tentacula or feelers. There are 23 species, some very beautiful: they are all inhabitants of the sea, and expand or contract themselves at pleasure: the anterior aperture serves them both as a mouth and a vent, and from the hinder one they reject water which had been previously sucked in: the tentacula are retractile.

LOBARIA, THE LOBED WORM.

BODY above convex, beneath flat, lobate. There is but one species, and it is rarely met with.

TRITON, THE TRITON.

GENERIC characters, Body oblong; mouth with an involute spiral proboscis: tentacula or arms twelve, six on each side, divided nearly to the base, the hind-ones cheliferous. There is but one species, which inhabits Italy, in cavities of submarine rocks, and may be seen in various species of *Lepas*, particularly the *anatifera*. It resembles the preceding in having the body oval, and its lower extremity rounded, and divided into lobes at the sides.

species: they are very simple, soft, smooth, naked, worms; inhabiting the Northern Ocean and the Greenland Seas.

PEDICELLARIA, THE STALKED WORM.

GENERIC characters, Body soft, and seated on a rigid stiff peduncle; aperture single.

The GLOBULAR PEDICELLARIA, *P. globularia*.

Head spherical, reddish, with the appearance of a small cherry; no neck; peduncle or stem tawny. This is shown on the Helminthology Plate III. fig. 7.

TETHYS, THE TETHYS.

GENERIC characters, Body detached, rather oblong, fleshy, without peduncles: mouth with a terminal cylindrical proboscis, under an expanded membrane or lip: apertures two, on the left side of the neck. There are two species, one inhabiting the Mediterranean, the other the Adriatic, about six inches long.

PTEROTRACHEA, THE FINNED WORM.

BODY detached, gelatinous, with a moveable fin at the abdomen or tail: eyes two, placed within the head. There are four species, one of which, the *coronata*, has both abdomen and tail furnished with fins, the head with a round perpendicular proboscis, and a coronet of 10 spines in the front.

DERRIS, THE DERRIS.

GENERIC characters, Body cylindrical, composed of articulations: mouth terminal: feelers two. —A new genus, instituted for a single species, described in the Transactions of the Linn. Soc. It inhabits the coast of Pembroke-shire. The body is cylindrical, gradually tapering to a point behind, composed of joints, and capable of great flexibility; covered

vered with a membranaceous transparent coat, through which the internal parts are visible. The head extends beyond the outer skin, and is less than the anterior part of the body, to which it is connected by a membranaceous covering forming a neck. Feelers white, situated at the top of the head, and capable of being raised or depressed at pleasure. Mouth consisting of two lips, the upper-one hooked and moveable, the lower-one straight and fixed. It moves by an undulatory motion of the whole body.

HOLOTHURIA, THE HOLOTHURIA.

GENERIC characters, Body detached, cylindrical, thick, naked, and open at the extremity: mouth surrounded by fleshy branched tentacula or feelers. There are 23 species, some very beautiful: they are all inhabitants of the sea, and expand or contract themselves at pleasure: the anterior aperture serves them both as a mouth and a vent, and from the hinder one they reject water which had been previously sucked in: the tentacula are retractile.

LOBARIA, THE LOBED WORM.

BODY above convex, beneath flat, lobate. There is but one species, and it is rarely met with.

TRITON, THE TRITON.

GENERIC characters, Body oblong; mouth with an involute spiral proboscis: tentacula or arms twelve, six on each side, divided nearly to the base, the hind-ones cheliferous. There is but one species, which inhabits Italy, in cavities of submarine rocks, and may be seen in various species of Lepas, particularly the anatifera. It resembles the preceding in having the body oval, and its lower extremity rounded, and divided into lobes at the sides.

LERNÆA, THE FISH-BITER.

THIS is a very curious genus, having a kind of oblong naked body; head destitute of eyes, but furnished with strong branched tentacula or horns, by which it insinuates itself between the gills of fish, and there sucks its nourishment; its ovaries are external, projecting like two tails from the lower extremity, which it glues on the cheek of the fish whereto it adheres, and there the young are hatched. There are 15 species, which infest as many kinds of fish.—The *branchialis*, which fixes on the gills of the cod-fish, is delineated on the Helminthology Plate III. fig. 6, with the ovaries in an advanced state of pregnancy. It is about two inches long; and eaten by the Greenlanders.—The *L. salmonea*, or salmon-louse, attains the length of six inches, and is a dreadful tormenter of the fish whose name it bears.

SCYLLÆA, THE SCYLLÆA.

GENERIC characters, Body compressed and grooved along the back: mouth consisting of a terminal toothless aperture: tentacula or arms three each side, and placed beneath. There are but two species, very small, and generally found attached to sea-weed.

CLIO, THE CLIO.

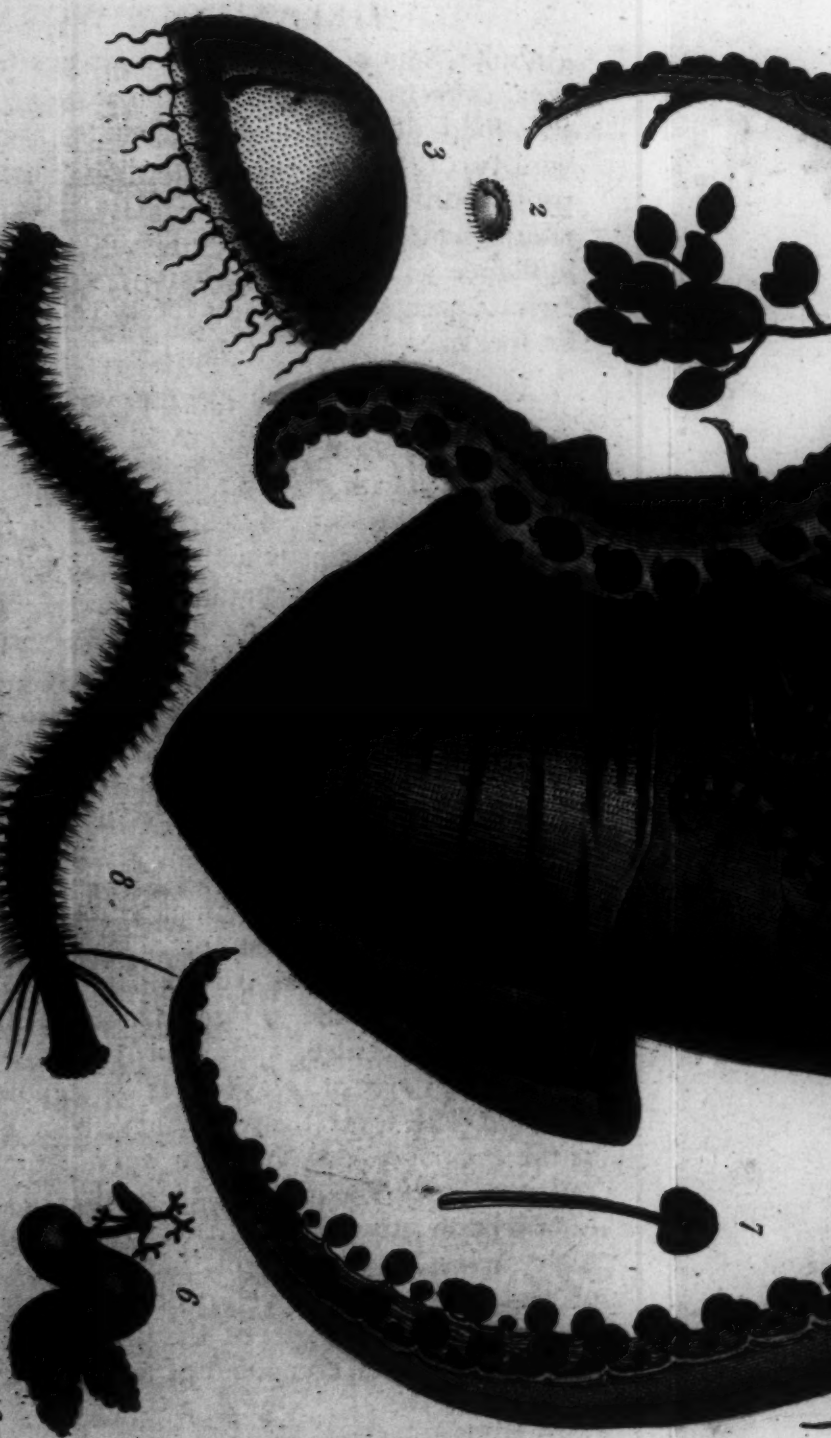
GENERIC characters, Body oblong, sheathed, and adapted for swimming; having two membranaceous arms or wings, which give it the air of an insect, though these are really the fins; it has likewise five tentacula, two of which are in the mouth. A native of the main sea, an inch and a half long; it gives a numbing or freezing sensation to the touch; is pellucid, and of an azure colour, when in the water, decorated with crimson at each extremity; it associates with the medusæ; the head is somewhat narrow, globular,

Order of Mollusca, or Spectator's Mollusca.

London, Published at the Art Director, Agents for the Art of the Mollusca.

August 20.

1/3





OF GELATINOUS WORMS. 547

globular, and divided into two cheeks by a longitudinal ridge or furrow, the terminal point of the mouth furnished with a lip on each side, armed in front with two bright shining teeth; the interior aperture protected by four, smaller and crooked; the two tentacula, which are situated in the mouth, are of a softer substance; the thorax generally globose, with submembranaceous wings, the throat yellow. There are six species.

SEPIA, THE CUTTLE-FISH.

GENERIC characters, Body fleshy, receiving the breast in a sheath, with a tubular aperture at its base: arms eight, beset with numerous warts or suckers, and in most species two pedunculated tentacula: head short: eyes large: mouth resembling a parrot's beak. There are 8 species. They inhabit various seas, and in hot climates grow to a prodigious size.

The GREAT CUTTLE-FISH, *S. loligo*.

This curious and singular creature is represented on the Helminthology Plate III. fig. 1. It is furnished with eight *brachia* or arms, interspersed on the interior side with little round serrated cups, acting as tentacula, by the contraction of which the animal lays fast hold of any thing that comes in its way. Besides these eight arms, it has two *brachia* longer than the other arms, and also pedunculated. The mouth is situated in the centre, and is horny, and hooked like the bill of a parrot. The eyes are below, and surrounded with several silvery rings; they are as large as the eyes of a calf, but are very prominent, and rather resemble the eyes of the crab. The body is of a reddish brown colour, nearly cylindrical. The belly below is equal, soft, smooth, oblong-round, of an ash and faintly-yellowish colour: about the middle of the upper part of the body, there is a fin, like those of fishes, composed of a softish cartilaginous substance,

substance, spread out widely on both sides, and decreasing towards the tail till it ends in a point, like the broad fins of the ray-fish: by means of this fin the sepia moves itself in swimming, having no other membrane for that purpose. From this pointed termination of the tail, the animal obtained the name of *lolius*, or *loligo*. The French call it *calamar*, and *araigné de mer*, or sea-spider, although it has scarcely any resemblance to the spider; but rather, with respect to the head, approaches to the shape of the *Asterias*, or star-fish. From the general description, especially from the size, this would seem to be the *S. octopus* of Linnæus. At any rate they are very formidable animals. With their arms and trunks they fasten themselves, to resist the motion of the waves. The females lay their eggs upon sea-weed and plants, in clusters like bunches of grapes. Immediately after they are laid they are white, and the males pass over and impregnate them with a black liquor, after which they grow larger, and resemble black grapes, as shown in the Engraving, at *a*. On opening the egg, the embryo cuttle is found alive. The noise of a cuttle-fish, on being dragged out of the water, resembles the grunting of a boar. When the male is pursued by the sea-wolf or other ravenous fish, he shuns the danger by stratagem. He squirts out a black liquor, by which the water becomes black as ink, under shelter of which he baffles the pursuit of his enemy. This black liquor is elaborated in a particular gland. The Romans used it as ink; and it is said to be an ingredient in the composition of Indian ink. The back-bone of this animal is converted into that useful article of stationery called pounce. In hot climates these creatures are found of an enormous size. The Indians affirm, that some have been seen two fathoms broad over their centre, and each arm nine fathoms long. When the Indians navigate their little boats, they go in dread of them; and, lest these animals

mals should fling their arms over and draw them under water, they never fail without an axe to cut them off. When used for food, they are served up in their own liquor, which from boiling, with the addition of nitre, becomes red. Bartholine says, upon cutting one of them open, so great a light broke forth, that at night, upon taking away the candle, the whole house seemed to be in a blaze.

LUCERNARIA, THE LANTERN-WORM.

GENERIC characters, Body gelatinous, shining, wrinkled, branched; mouth beneath. This is an animal consisting of a lump of glistening jelly, without head or eyes; it however protrudes an arm from the angles of the body, each of which is furnished with from thirty to forty tentacula, retractile, and employed in catching its prey, which it turns into an orifice in the centre of its mass of body.

MEDUSA, THE MEDUSA.

GENERIC characters, Body gelatinous, orbicular, and generally flat underneath: mouth central beneath.—There are 44 species; they consist mostly of a tender gelatinous mass of different figure, furnished with arms or tentacular processes proceeding from the lower surface; the larger species when touched cause a slight tingling and redness, and are usually denominated *sea-nettles*: they are supposed to constitute the chief food of cetaceous fish; and most of them shine with great splendour in the water.

The HEMISPHERICAL MEDUSA, *M. hemisphærica*.

Specific character, hemispherical, with four transverse ribs beneath, and marginal tentacula and globules. It inhabits the European seas; and is about two lines in diameter. This species is represented on the Helminthology Plate III. fig. 2, of its natural size, forming a vast contrast with the cuttle-fish on the same

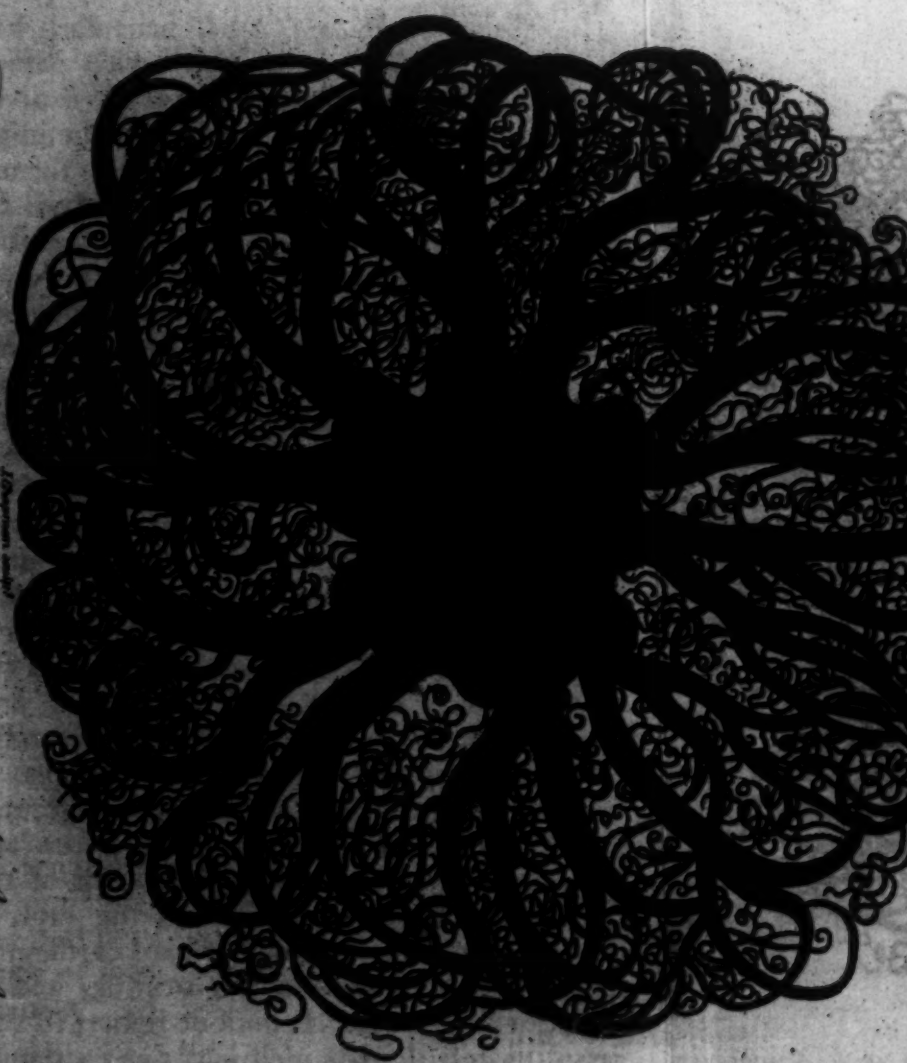
same plate. Its appearance is that of a drop of transparent jelly; and so minute are the red globules or bases of the tentacula which surround the disk, that they are scarcely to be distinguished without the help of the microscope. Yet has this little creature, when it fails in quest of food, the faculty of expanding its tentacula or arms to a size equal to that which is shown at fig. 3.

PHYSSOPHORA, THE PHYSSOPHORA.

BODY gelatinous, pendent from an aërial vesicle, with gelatinous sessile members at the sides, and numerous tentacula beneath, whereby it has the appearance of a full-blown flower hanging downwards. There are but 3 species; and these, being nearly allied to the Medusæ, might without much impropriety be removed into that genus.

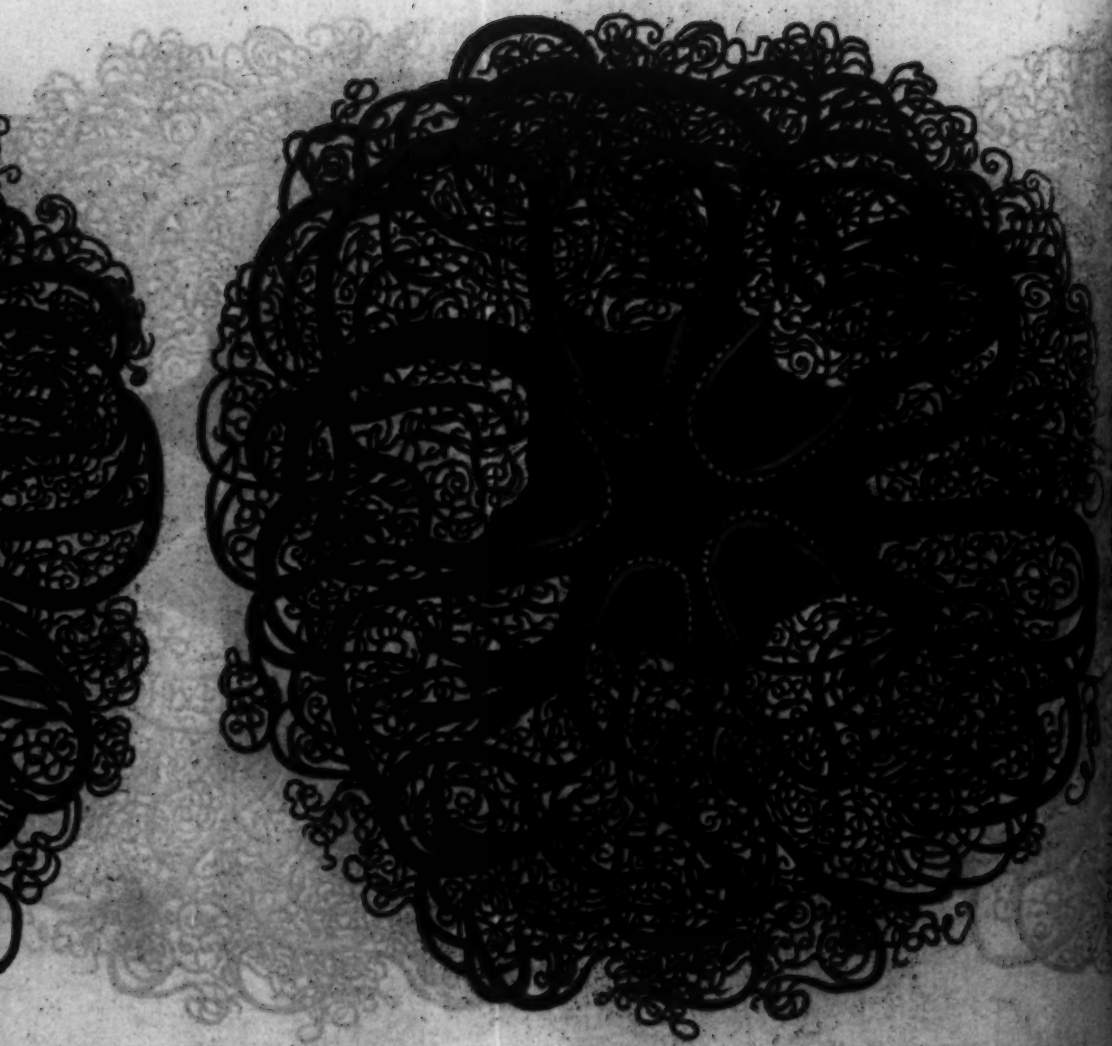
ASTERIAS, THE STAR-FISH, OR SEA-STAR.

GENERIC characters, Body depressed, and covered with a coriaceous coat, composed of five or more segments, running out from a central part, and furnished with numerous tentacula, having the mouth in the centre. The conformation of the mouth is this: the under part of each lobe runs towards a point with the rest at the centre of the body; and these several productions of the rays make a sort of lips, the ends of each of which are armed with a number of sharp teeth, which serve to take and convey the food into the body. From this mouth there goes a separate canal to all or many of the rays, which runs through their whole length, and becomes gradually narrower as it approaches the extremity. The tentacula resemble the horns of snails, but serve the animal to walk with. They are capable of being contracted or shortened: and it is only at the creature's moving that they are seen of their full length; at other times, no part of them is seen but the extremity of each, which is formed.



The Captain, Methuen, or, Magellan's Star-fish.

London: Published at the end of the year 1818, by J. Smith.



formed like a sort of button, or bead, being somewhat larger than the rest of the horn. Forty-five species have been ascertained.

The MACELLANIC STAR-FISH, *A. Caput Medusæ*.

This is called *Medusa's head*, because it bears some resemblance to the snaky hair which painters have made peculiar to Medusa. The body is divided into five parts or rays, as may be seen in the upper figure of *ASTERIAS* Plate I. which represents the under part of the animal. In the centre are observed some hollow rings, which, as it is supposed, constitute the mouth, since they are furnished with pores, through which the creature receives its nourishment in the water. To the under part of the five rays are affixed a great number of legs, disposed in order, and by the help of these the animal contrives to walk, though but slowly. In the space between is a black thick skin, that covers the back or upper part of the body, which is divided by ribs, as shown in the lower figure; from the centre of which grow out five double, or ten single, arms or rays, of a yellow or reddish colour, and ranged two and two. The rays are subdivided into two parts, and each of these into two other branches, which successively become in proportion smaller or more numerous, till the ray terminates in an infinite number of small ramifications. All the branches, beginning from the body, were, in the animal represented in this plate, about a foot and a half long, and the animal measured upwards of three feet in diameter. The body, and all the rays, even to the extremity, are composed of hard cartilaginous vertebrae, which resemble a star or disk, and are furnished with a prickle. It must be remarked that every ray ultimately disparts itself into 512 extremities; the five rays therefore all together are separated into 2560. Now, every branch, having 512 extremities, is composed of 1023 joints; the five rays therefore consist
of

of 5115. As every ray contains upon an average six vertebræ, there are all together 81,840 cartilaginous vertebræ; when therefore one of these creatures comes to its full and perfect growth, the joints, extremities, and vertebræ, multiplied together, produce a number almost incapable of being counted! As the ancients ranked this creature among the vegetables, they were doubtless of opinion that it drew its nourishment through a number of pores, somewhat like flowers which grow in the water. But Linnæus, and all the modern naturalists, find its mouth very distinctly in the centre, where five valves are united in a point. All the claws and joints are moveable, and lie extended in the water, which makes the animal appear perfectly like a flower in full bloom. It is oftentimes found upon a rock, or twisted round a coral. In order to take them, they touch them with a stick, to which they immediately adhere. When drawn out of the water, they hang down loosely like a bundle of flax; and when put down to be examined, they contract themselves and become hard. The fragments of these rays or claws furnish the fossil entrochi. If we drown this animal in brandy or spirits of wine, and keep the rays flat and expanded in the execution, it is easy to extract, by means of a pair of forceps, the stomach of the animal whole and entire through the mouth. This species is found in the Indian Ocean, and at the Cape of Good Hope. In the North Seas, and near Archangel, it is said some are found of a prodigious size. The Caspian sea, however, abounds with the largest sort of them.

The COMMON STAR-FISH, *A. rubens*.

Specific character, body with five lanceolate convex rays, covered above with single spines disposed in rows. Of this species the whole substance appears like an assemblage of bones in the form of wedges, which in their size and figure resemble small brushes,
and

and are supposed to be the young of the parent animal; every one of which, as they increase in bulk, and approach to maturity, falls off from the parent, and becomes a separate star-fish. M. le Kade, having anatomised an *Asteria rubens* of Linnæus, has described the interior parts of the star-fish with great accuracy. In the centre of the inferior surface is discovered an opening, which divides itself into five furrows, extending to the extremity of each ray. At this aperture is observed a great number of points, and each side of the furrows is furnished with the same, every one of which is supported by a small vesicle on the side of the furrow, which perfectly resembles a hand with five fingers. By the help of these points or nipples, which amount from five hundred to a thousand, the animal appears to advance along the bottom of the sea, though indeed exceeding slowly, and almost imperceptibly. The mechanism of this motion consists in the vesicles, which are placed under these points or legs, being filled with a clear liquid, by the pressure of which the legs are forced out; and they again contract themselves as soon as the liquor runs back, like the horns of a snail. In the water the motion becomes more nimble, probably because in a fluid the resistance is not so great. The five sides in general form a regular pentagon; but, when the animal is drawn out of the water, it is with great difficulty the rays are kept from being disfigured, and put out of their place. The natural colour of these creatures is blue, but when dried they become of a brownish yellow. When star-fish, which otherwise attract the damp, and retain the smell of salt water, are demolished by putrefaction, or killed by any accident, they appear like a heap of grains; and it is affirmed, that not only every little piece, but even every vertebra, produces a new animal; and hence it is that any individual which has been mutilated, so soon recovers itself; for the rays or arms, after having

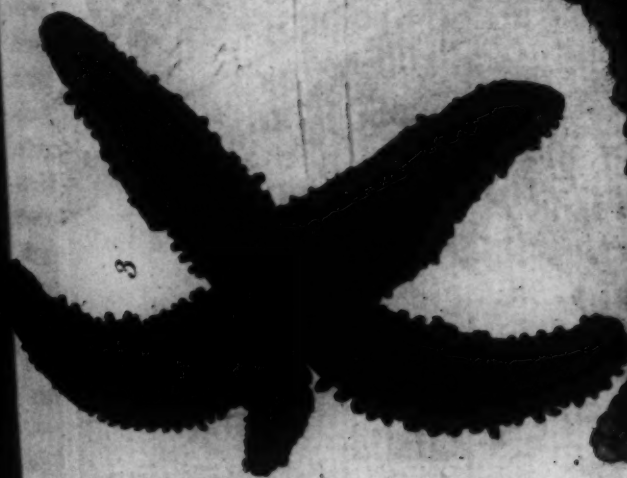
Vol. XIII. No. 178. 4 A been

been broken off, will regenerate, and grown again; which fact is clearly proved in the subject from which fig. 3. Plate II. was engraved. This creature had by some accident lost the fifth ray; but the accretion of a new one, small, and just growing out, is plainly to be seen in the plate. Fig. 4 is the upper side of a specimen which was found with only four rays; and fig. 5 is the complete animal with five rays. Inhabits the East-Indies, the Antilles, and the Gulf of Mexico.

The RETICULATED STAR-FISH, *A. reticulata*.

Specific character, rays four, reticulate with prickles. The whole substance is composed of muscular and cartilaginous excrescences; the small bones, which are found in the interior part of every ray, and which spread themselves through it, are of an oblong figure, and have a large surface upwards like a blade-bone; and, being placed one after the other, represent a sort of net-work. The other bones are small spherical substances, of unequal surfaces, which have on the outside the figure of a nipple, from which projects an apophysis or cartilaginous protuberance. But, when these bones have attained their full size, they are in the shape of a star, like those towards the centre part of the animal. The number of these may perhaps amount to some thousands. They are all united together in a tough substance resembling shagreen, and seem on the outside to be an assemblage of small points or grains, like millet or poppy seed, which probably increase by degrees, and constitute the growth of this creature. The interior part of them is a mucilage, composed of vesicles placed under the bones, which seem to assist the motion of the apophyses, as they expand and contract themselves alternately. Inhabits the Indian Seas. The number of rays is by no means constant: Knorr has described and figured a beautiful specimen with five rays, which we have copied in the annexed Plate II. fig. 1.

The





J. Chapman sc.

Star Fish

Enslaves Published in the Anatomical Magazine & Natural History

The SNAKY STAR-FISH, *A. ophiura*.

Specific character, the disk scaly; scale of the angles serrate. A species very common in the North Seas; but the one represented fig. 2, Plate II. is much larger and darker, and was found in the American Ocean. The upper surface of this animal is composed of rings or vertebræ, which communicate a power of motion to the rays or arms on every side. The rays are of a membranaceous substance, and very tender. Its colour is blue when in the natural state; but when dried becomes reddish or ash-coloured. This species is found on rocks, and between lumps of coral, to which it will firmly adhere. It has the power of quick motion, its rays being entirely composed of regular vertebræ.

The PRICKLY STAR-FISH, *A. aculeata*.

Specific character, body round, or pentagonal, or in the shape of a flower; and every ray has four rows of thorny points, so that every vertebra has four prickles. On the under surface of the rays, between the vertebræ of the sides, are a great number of pores, in the form of little dots or points; and the mouth consists of an aperture in the centre, in the form of a star. These are natives of the American Seas. See Plate II. fig. 6.

ECHINUS, THE SEA URCHIN.

GENERIC characters, Body roundish, covered with a crustaceous shell, beset with moveable prickles; the mouth is below, and consists of five valves. Many species have hitherto only been found in a fossil state, and constitute the *echinites* and *centronia* of different naturalists. The pores are each furnished with a retractile tentaculum or feeler, by which the animal fixes itself to any object, and stops its motion: the spines are connected to the outer skin by very strong ligaments, and are

the instruments of motion. The echini are all sea-animals, mostly of a round or oval form, included in a substance more or less hard, but always very brittle, not dividing into laminæ, but of a porous appearance like sugar. Their round shape acquired them the trivial name of sea-buttons; but, as their covering is almost always beset with prickles, they are generically called *echini marini*, or sea hedge-hogs.

The substance of the animal is gelatinous, interspersed with many fibres, almost like the spleen, lungs, and liver, of other animals. The covering is generally divided into five plots, or chambers, proceeding from the mouth, which in some species is furnished with five teeth, or long cutting bones. These animals, when boiled, become hard like an egg: some species may be eaten, but most of them are rejected on account of their disagreeable taste. The shell has always two apertures, one of which is constantly in the centre at the bottom; this is the mouth. The other aperture is sometimes underneath, and beside the mouth; but it is often in the centre at top; this is the vent, whence the excrements are voided. In all the species the shell is flatted underneath and raised or vaulted above; and the raised summit is either round and flat, or convex, or oval, or conical. Several of them have the compartments furnished within with five filaments running round the mouth, which unite, and strengthen the five lobes of which the body of the animal is constituted. The marks of this separation into five lobes is always visible externally; for in every one we may observe five striæ, or sutures, or furrows, either single or double, or some other figure consisting of five lines. The pieces of the shell or covering, which are some hundreds in number, are mostly hexagonal: and upon each there is a warty tubercle, (called by Knorr *mamellon*, nipple,) or else a round cavity, which holds the spine by means of a tendon which runs through the centre of the tubercle

cle or cavity. An union of all these pieces makes up the five lobes; and these by a regular suture are themselves joined as the bones of the cranium are by their sutures. The spines are either thick or thin, smooth or rough, short or long, and of various shapes, sometimes as thin as a bristle or hair; their colour is also variable; being white, red, green, brown, black, violet, yellow, and variegated. The spines are used by the animal both for defence and for motion, and he can raise or depress them at pleasure. If we offer to drag one of these animals from a hole in a rock, he raises his spines all round, and fixes them so firmly against the sides of the hole, that it is impossible to draw him out. When they would remove from one place to another, they make use of the longest spines, which they move either all together, or one after the other, somewhat like a man walking with crutches. In this manner they proceed at a tolerable rate, especially on the firm banks. But they are never seen rolling like a ball, for they can stop themselves in a moment by pushing out some of their spines; and, if by any accident they are thrown topsy-turvy, they can turn by means of their spines. in the same manner as a beetle uses its legs when thrown on its back. These spines, as before observed, are attached by a thin tendon to the tubercles; but the slightest touch brushes them off when the animal is dead; and hence the sea-urchins preserved in cabinets are most frequently without prickles. To keep them entire, they should be immersed in spirits as soon as taken out of the sea, that the spines may stiffen, and coalesce more firmly.

The hard surface of the shell is covered with a very thin epidermis, which seems fastened to the body by an infinite number of filaments, passing through as many minute holes, or pores, in the covering, and holding together the numerous pieces of which it consists. These pores, almost imperceptible to the naked

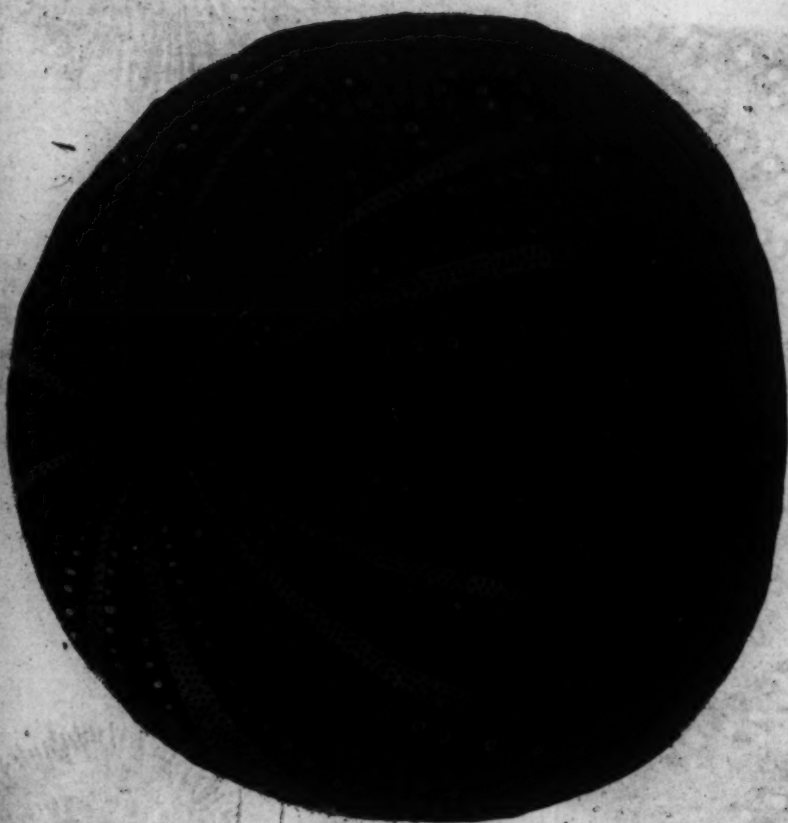
naked eye, are commonly placed in ten regular rows, which form an arc reaching from the vent to the mouth of the animal. Most of the echini have five large escutcheons, covering the five divisions; and at the edge of each escutcheon is a regular row of large tubercles, behind which is a row containing many hundreds of minute pores; but in the middle of each escutcheon, instead of pores, are many small tubercles, placed without order. Thus the escutcheons, being joined two and two by a regular suture, form two rows of tubercles, on each side of which are the rows of pores; thus forming ten rows. In other species, which have no tubercles, the spines arise from small points on the shell, or from little circular indentations. The echini present a great variety of beautiful tints and curious forms, many of which are highly valued in collections. There are 109 species; and we have devoted two plates to exhibit some of the most curious.

The ESCULENT SEA URCHIN, *Ech. esculentus*.

This is subglobular, with ten avenues of pores, the spaces between covered with small tubercles supporting the spines, which are sharp and strong, above half an inch long; commonly of a red or violet colour; moveable; the tubercles elegantly disposed in rows. These are found in the European and Indian seas. In old times they were a favourite dish, and thought grateful to the stomach: they were the first dish in the famous supper of Lentulus, when he was made *flamen Martialis*, or priest of Mars. This species is exhibited in the Echinus Plate I. without spines, at fig. 1. The entire animal is armed like the back of a hedge-hog, and appears of a reddish or yellowish colour, the spines faintly violet, purple, or reddish; they are smooth, solid, and so hard, that if they fall on boards or stone, they sound like metal. At the lower extremity, which is somewhat thicker,
each

ECHINUS.

Plate 1.

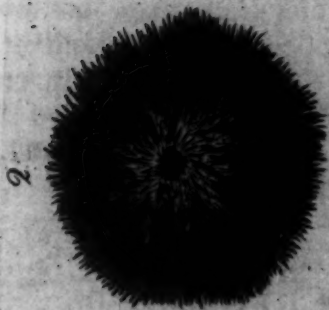
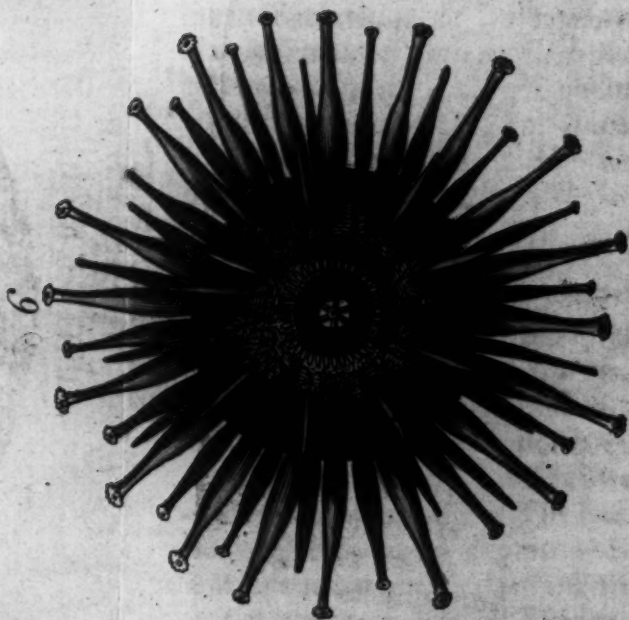
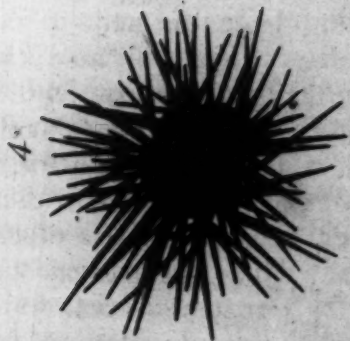


3



5





J. Chapman del.

Curious Species of the Sea Urchin.

London Published as the Act directs Oct. 20. 1825 by J. Williams

each spine is hollowed to embrace the top of the tubercle, as represented in the engraving. There is a variety, of which the prevailing colour is white, and the spines brown.

The MILIARY SEA URCHIN, *Ech. miliaris*.

Hemispherical depressed, with ten avenues of pores, the spaces between with two rows of protuberances. The spines are dark green; and round the base of each is a round knob, or several knobs one under the other, at the bottom of which is the hollow which joins the tubercle. The tubercle is almost spherical, and stands on a rising of the shell, so as to represent a wart or nipple. There is a variety which is green and reddish white; the spines green, and reddish at the tips. Another variety with short but very beautiful spines is almost entirely purple. This is represented in the engraving at fig. 2.

The ANGULAR ECHINUS, *Ech. angulosus*.

Hemispherical; the spaces granulate and bifarioussly warted, the larger ones biparted by a ferrate suture down the middle; avenues trifarioussly porous. Shell grey, with a greenish violet tinge; spaces with rows of granulations and protuberances; avenues with double distant pores. There is a variety described by Knorr, smaller than the above, and of a light greenish colour. In the middle of each division is a line, not perforated with pores, but with a row of tubercles on each side of it. Behind these rows are two lines pierced with a vast number of pores, and bounded by a single row of tubercles, to which joins the dentated suture which connects the parts. The lobes themselves consist of an infinite number of little squares, each bearing at least one tubercle. The mouth is pentagonal; on each lobe within there is a raised hook like an arched door, and two furrows belonging to each lobe at the rim of the mouth.

The

The vent is at the apex, and is covered with a cartilage which reaches over the pentagonal perforated rim described under the first species. The shell is thin, and very brittle. Another variety has been observed with the apex red, and red spots on the tubercles. But of this species of echinus there are more than thirty varieties: some either light or dark green; others green with white lines, white with green lines, transversely striped, or spotted white or green. The present variety is delineated in the engraving at fig. 3.

The STONY ECHINUS, *Ech. saxatilis*.

This is also hemispherical, depressed: pores of the avenues in a curved line, the curves oblique at the base. Inhabits the Mediterranean and Indian Seas. Shell sub-elliptic, violet-grey or white; protuberances violet, reddish, or yellowish, in two or three longitudinal rows; pores of the avenues double, five pair in a row; mouth large; vent surrounded with ovate acute scutes; spines rigid, reddish-brown, with violet tips. This is good food. The spines are long, smooth, solid, spear-shaped, of a brownish colour, and give a metallic sound when they fall. In the middle appears the mouth, armed with its teeth, which are five triangular bones, hollow, and bent; their points unite outside the shell, and form a cone; their broad extremities are within, placed circularly. This is exhibited in the same engraving at fig. 4.

The LITTLE TURBAN, *Echinus diadema*.

Hemispherical, depressed, with five avenues longitudinally tuberculate; the spaces lanceolate. It varies, 1. With tuberculate bands. 2. Greenish yellow. 3. Blackish, variolous, with long spines. 4. Spines black, annulate with white. This species inhabits the sands of the Indian Ocean. Shell orbicular, with a depressed top, rich blue or grey-blue; mouth large; vent circular and surrounded with a pentangular skin; spaces

spaces bifariouſly tuberculate, the tubercles perforated at the tip; avenues with three pair of pores at the baſe and one at the tip; ſpines violet and blue-grey. This deſerves notice in preference to ſeveral others, from the regularity of its ſtructure, and the circular arrangement of its ſpines, as ſhown at fig. 5, in the engraving. It has been obſerved that the ſhell of the ſea-urchin, before it is cleaned, is covered with a tender ſkin: this probably enables the animal to unite and ſtrengthen its brittle ſhell, which conſiſts of ſo many diſtinct pieces. Yet this ſkin may be ſoftened in warm rain-water, ſo as to be removed by a brush; and the ſhell, being then expoſed to the ſun, becomes white, only the ten ſingle or five double lines remaining black.

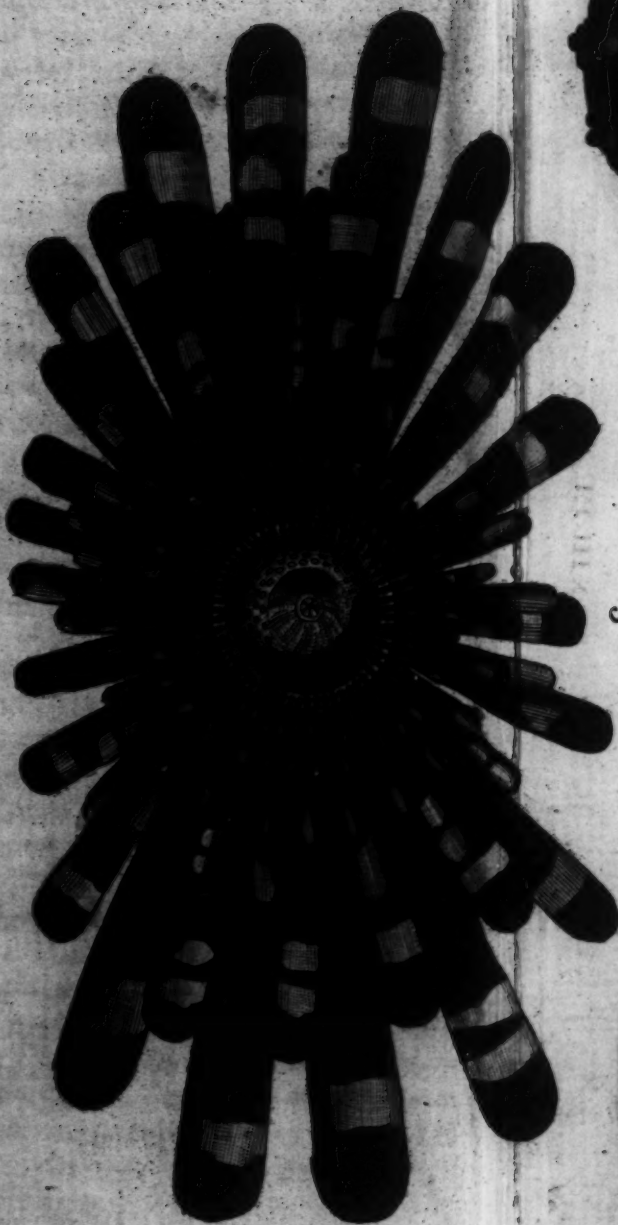
The GREAT TURBAN, *Ech. cidaris*.

Hemiſpherical, depressed, with five flexuous linear avenues, the ſpaces alternately bifariouſ. Its varieties are, 1. Of a ſmaller ſize. 2. With the ſpines fuſiform. 3. With the ſpines clavicate. 4. With the ſpines obtuſe.—This ſpecies inhabits the Indian Ocean; generally of a livid-grey colour, and flat at the baſe; ſpaces granulate; with two rows of protuberances placed alternately, furniſhed with perforated papillæ, ſurrounded with a circle or two of granulations, and ſeparated by a groove running round them; in the place of ſmaller ones is an eminent band between the avenues; mouth rather large. The tubercles are pretty large, regularly placed in five double rows; between each double row runs a thick line ſomewhat waved, which diſtinctly ſhows the five compartments of the whole ſhell, each of which contains two rows of tubercles; and each tubercle ſtands upon a white nipple, incloſed in a raiſed granulated border. The two rows of tubercles on each diſiſion go from the vent to the mouth, but not in ſtraight or parallel lines; they run rather oblique and alternate,

i. e. the tubercle in one line stands opposite to the space in the other. By the side of each double row of tubercles runs a waved broad stripe perforated with oblong holes; and these stripes divide the shell into five lobes. The tubercles look like buttons, and are of a yellowish colour; in the centre of each may be observed the orifice through which the tendon passes which fastens the spine to the shell or body. The spines are very large, and club-shaped; but they are of different sizes according to the size of the animal. A cidaris or turban with its spines complete is now considered as a great curiosity.

The variety of the cidaris with fusiform spines is nevertheless the most rare and beautiful of this family. The spines are large and swelled at the base, but grow small towards the top, which is terminated with a rim; and there are longitudinal striæ upon each, made up of raised dots, so that they have the appearance of being notched. Sixty of these have been counted upon one sea-urchin, without reckoning the young ones that might afterwards push forth. Each spine stands in the midst of a circle consisting of about twenty little white leaves rising up taper like a crown, concealing and strengthening the base of the spine; and between the rows of spines there is a double row of these leaves, directed opposite ways to support each row of spines. The anus is at the apex, and round it are five spines placed pentagonally; the mouth is at bottom, and included in a double row of ten short spines. All the rest of the spines are long. This species is often found petrified; but seldom in its natural state, since it inhabits the inaccessible depths of the sea. One of these is represented in Plate I. at fig. 6; and one of the triangular spines of the clavicate species, just above it. The shell also of the clavicate cidaris, without the spines, is exhibited in the Echinus Plate II. fig. 1, to show its tubercles, stripes, and perforations.

Another

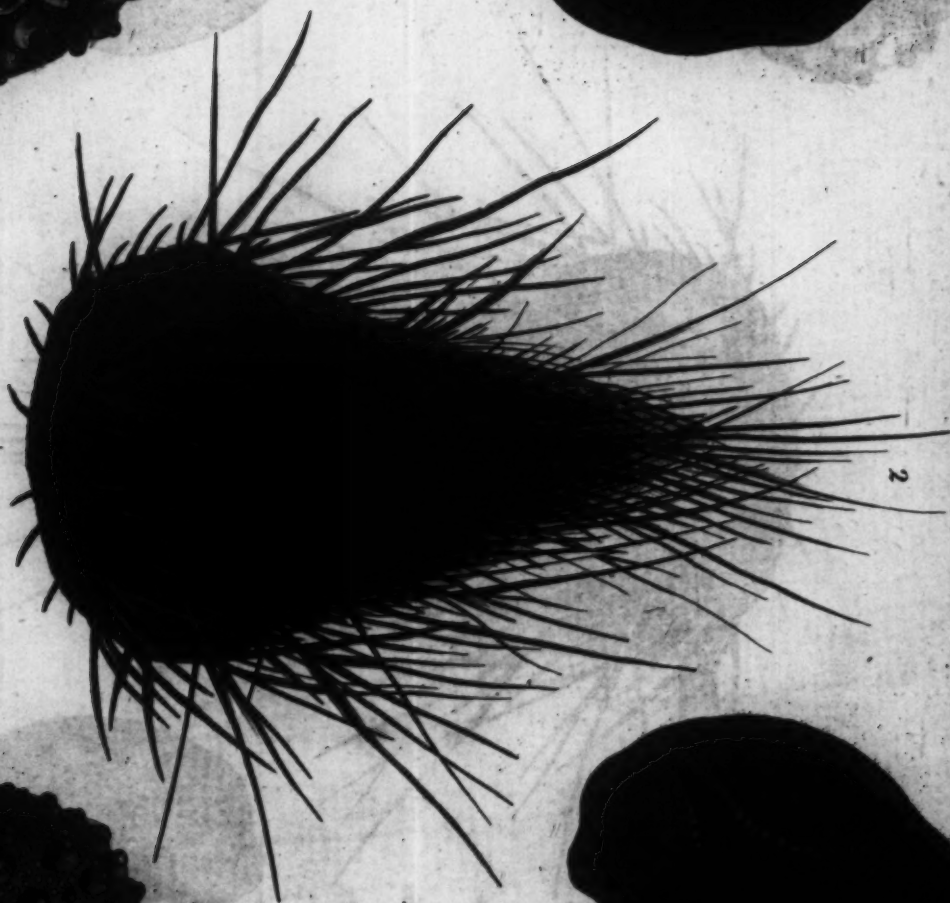
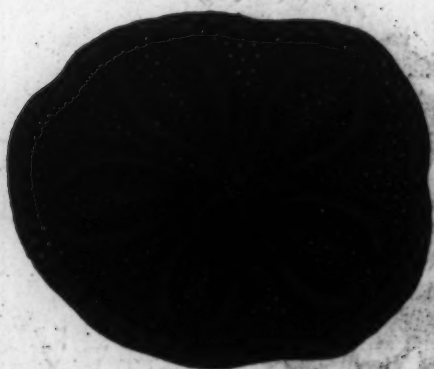
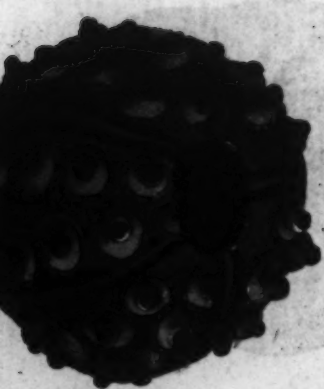


3

Curious Species of the Sea Urchin.

London, Published on the last day of October by J. Miller.

J. Chapman, &c.



Another variety of the *cidaris*, remarkable for the singularity and length of the spines, is referred by Knorr to this species. Its tubercles are placed upon nipples, like the great turban. This is sometimes called the *little turban*, (though it be the size of two fists,) because the tubercles are smaller. It is covered with a black skin; but when cleaned with soft water and a brush, and exposed to the air, it becomes white, and the ten black striæ which divide it appear. The spines are from two to six inches long; and are very rarely seen in cabinets unless separately. They are very thin and brittle; of a dark brown colour; the lower extremity not thicker than a large pin, and the point very fine: their structure is made up of a number of little rings, so finely serrated as to be invisible to the eye, but very perceptible to the touch; for they feel smooth when drawn between the fingers upwards, but rough when stroked downwards from the tip. It has as many spines as tubercles; the longer spines arising from the largest tubercles. Some specimens have the spines speckled, that is, the rings are alternately white and black. These are very beautiful and rare. This curious variety is correctly shown in Plate II, fig. 2.

The MAMILLARY ECHINUS, *Ech. mamillatus*.

Hemispherical oval, with ten winding avenues; the spaces muricate and warty, the narrower ones abbreviated. Inhabits the Southern Seas; and is valued as a nourishing and savoury food. Spaces ten, the papillæ not perforated as in the last, but surrounded with elevated circles; in the larger spaces are from sixteen to eighteen protuberances, the middle ones larger, in the lesser spaces about fourteen; avenues with four or five pair of pores at the base; mouth large; vent rounded, and surrounded with ten scales, five of which are perforated; colour of the spines variable. The back is more raised and pointed

pointed than in the preceding; not resembling a compressed sphere, but rather oblong-hemispherical. The tubercles are large, but not so regular as those of the preceding; neither are the divisions so distinctly separated. It is not therefore difficult to distinguish them, though they have often been confounded. Between the large tubercles are disposed a great many small ones, not larger than millet-seed. The shell is of a reddish colour, or like apple-tree blossom. The spines, from their rounded form, are called *fingers*. This species is represented in Plate II. fig. 3; and the shell, without the spines, at fig. 4.

The ROSE ECHINUS, *Ech. rosaceus*.

Specific character, flattish, and roundish-oval; avenues five, oval, like an open rose, with a dotted surface. Inhabits the Asiatic Ocean; yellowish-brown, sometimes dirty cinereous; covered with small tubercles like grains of sand, and disposed in a quincunx form. The shell is compact, and almost of a stony hardness, which however it acquires after it comes out of the water. There is a pentangular piece at the top with five angular holes, like those species which have the vent at the apex; yet in this division the vent is underneath, not in the centre however, but in the circumference. From this pentagonal piece arises a five-leaved figure which spreads over the whole surface of the shell, so that each side of the pentagon is contiguous to the point of one leaf, which is formed by two curved lines, representing the edges of the leaf, and these, making an oblong arc, pass over the shell, without joining at the round extremity of each leaf. The lines are broad, containing, first, two almost parallel rows of pores, the outer row large and oval, the inner smaller and round; from each oval hole of the outer row runs a furrow towards the round hole of the inner rank, which gives the edges of the leaves a singular appearance. The middle of each leaf,

leaf, inclosed in this edging or border, is much raised above the surface of the shell, so that this five leaved figure is very apparent. As the entire circumference of the shell represents a lengthened oval, broad at one end and pointed at the other, and in general a pentagon more or less obtuse, there are always two leaves of the figure divided towards the broad end, one to the pointed end, and the two others stretch towards the sides. The whole surface is full of little circular hollows, with a little convexity in the middle to hold the concave extremity of the spines, like the articulations of bones, as before described. Turning this to examine the base, two cavities appear. The largest, which is in the centre, is the mouth; the other, near the rim in the middle of the broad side, is the anus. The mouth is sunk in so far as to be within a very small space of the summit on the opposite side. From the rim to the mouth run five smooth deep furrows, which are precisely underneath and in the middle of each of the leaves of the figure above, and which thus divide the base into five parts. The shell also includes a great number of little bones, which are the teeth of this singular animal, and which rattle when the shell is shaken. This very curious species is exhibited in Plate II. fig. 5.

The FURROWED ECHINUS, *Ech. lacunofus*.

Specific character, ovate, gibbous, with five depressed avenues. Inhabits the Indian, Atlantic, and European, Seas. Shell with a purplish top; spaces tuberculate, in waved rows; the lower side fluted and divided by two smooth spaces; spines short, thick, mixed with long ones. The compartments are divided by deep furrows, four of which are narrow, but one is extremely broad, and almost as deep as half the convexity of the apex; it has a double row of pores at the bottom, and wrinkles on the sides; it reaches round the shell to the mouth; opposite this furrow,

furrow, on the top, there is a long deep future, which goes to the vent in the circumference of the circle. The shell is very thin; furnished with rough dots or grains, to which the spines adhere.

The following varieties are included by Gmelin under this species. The first inhabits the Adriatic sea. It has a raised lobe in the middle; on each side of which are four double lines, each consisting of two rows of pores; the longest lines are directed towards the broadest extremity, and form a curve towards the shorter ones at the pointed end. The whole is somewhat in the shape of a heart, the large end being divided, the smaller end contains the vent, and the mouth is underneath. The shell is very thin and brittle. This is represented in the Echinus Plate II. fig. 6. The spines are not thicker than horsehair, and about a quarter of an inch long; when they are on, the shell is entirely covered with them, so that neither furrow, future, nor aperture, can be seen. The second variety resembles the preceding; but the spines are long, and curved at the ends like a sabre. Some have a smaller set of spines, of a whitish colour, intermixed with the brown ones, probably young ones to replace those which fall off.

ORDER III. TESTACEOUS OR SHELL WORMS.

THE animals which form this order are of a simple structure, gelatinous and soft, being no other than Molluscæ with the addition of a calcareous habitation; the rudiments of which being formed in their embryo state, they carry it with them during the whole of their lives. The genera are 35 in number; three of which are distinguished by shells formed of several segments or valves, whence they are denominated *multivalves*; fourteen others, whose habitation consists of two shells, as the mussel, oyster, and cockle, kinds, are termed *bivalves*; and the remainder,

der, which have only one shell, are called *univalves*. These genera are formed upon characteristical distinctions, arising in the first class from the form and number of the valves; in the second from the number and kind of articulations in the hinge; and in the third from their spiral turn, form of the aperture or mouth, teeth, pillar, &c.

All those worms which inhabit the multivalve and bivalve shells, are endued with the faculty of opening and shutting them at pleasure; for the purpose of obtaining their food and nourishment; and also with a powerful instinct, which, though blind and imprisoned, yet unerringly directs them in all their haunts after prey; and which, on the slightest touch or disturbance, warns them of danger, and excites the instantaneous closing of their valves, and thus foiling an enemy. Their sense of touch must be extremely delicate, since the finest point communicated ever so gently to the external part of the shell of a mussel, cockle, oyster, &c. directs them in a moment to close their valves, and to exert their utmost strength to keep them shut. This sense appears to be communicated by delicate nerves and membranes, and perhaps by the fimbriæ which skirt the shell; but the seat of the senses must undoubtedly have its place in that part of the animal which resides nearest the hinge, as well for its greater security, as for the direction of its valves, and the operation of all the included parts; which present to the curious physiologist a wonderful display of the beautiful mechanism with which the Almighty has formed them.

CHITON, THE CHITON.

GENERIC characters, Animal inhabiting the shell a doris; shell consisting of several segments or valves disposed down the back. The name is from *χiton*, a coat of mail. There are 28 species; they are found

found in almost every sea, and are common near the shores of Scarborough, Aberdeen, and Lochbroom.

LEPAS, THE ACORN AND BARNACLE.

GENERIC characters, Animal a triton; shell consisting of many unequal erect valves, and fixed at the base. But the manner in which the shell is fixed in the different species has caused some to divide this genus into two families, (though such division is not noted by Gmelin,) namely, the *balani*, or acorn-shells; and the *anatifera*, or barnacles. The species in the former division are constantly fixed by their base to stone, rock, wood, or other substance, where they immovably grow, as expressed in the generic character. The *anatifera*, on the contrary, adhere only by a slender petiole or tendinous tube, which, being of a soft flexible nature, affords to this division the privilege of moving or twisting about in a circular direction in search of their food. Of this latter division is the *Lepas scalpellum*, which, in the Helminthology Plate IV. fig. 4, is shown in its quiescent state, fixed by its tube, and its tentacula or feelers retracted and at rest. At fig. 5, the same animal is represented with its tentacula projected, and the valves or shells somewhat opened, to receive its nourishment. It is furnished with thirteen valves, six on each side, and one at the back, curved, and inclosing the others. The peduncle is beautifully annulated, soft, and flexible.

The *Lepas anatifera*, belonging to this division, being generally found in clusters upon the roots of trees growing under water, and upon old pieces of floating timber, was formerly supposed to be the origin of the barnacle-duck. For a full confutation of this absurd notion, see vol. v. p. 170 & seq. It will hardly be credited, that in the present year (1808), a piece of wood picked up at sea encrusted with these worms has been exhibited in London as a duck or goose tree. The shells of the worms are affirmed to be duck-eggs; and

OF TESTACEOUS WORMS. 569

and the exhibitor pretends to show the foolish multitude (at one shilling a-head) the bills and feathers of the fowls emerging from them!

PHOLAS, THE BORER.

THIS is the third and last genus of the multivalves; in which there are twelve species. Linnæus calls it a *bivalve* with accessory valves at the hinges. The animal is an *ascidia*, which has the singular property of insinuating itself, while young, into soft porous stone and wood, and as it increases in size it enlarges its habitation within, and thus at length becomes imprisoned. These animals were formerly called *pid-docks*; and are furnished with a phosphoric liquor of great brilliancy, which illuminates whatever it touches or happens to fall upon.

MYA, THE PEARL-OYSTER.

GENERIC characters, Animal an *ascidia*: shell bivalve, generally gaping at one end: hinge with broad thick strong teeth, seldom more than one, and not inserted into the opposite valve. There are 26 species. These animals perforate into the sand and clay at the bottom of the sea, burying themselves and their shells, wholly or in part, in the mud, like the mussels, with which they were ranked, till Linnæus parted them; hence the fishing for them is attended with considerable difficulty.

The TRUE PEARL-OYSTER, *M. margaritifera*.

Specific character, shell ovate, a little contracted in the middle of the thinner margin: primary tooth of the hinge conic: protuberant parts near the hinge decorticated. This shell is noted for producing large quantities of mother of pearl and pearl, the latter being a disease of the fish analogous to the stone in the human body. The river Conway in Wales was formerly famous for producing pearl of great size and

value. The species inhabits most parts of the Arctic circle, and is generally found in mountainous rivers and about cataracts; about five inches broad and $2\frac{1}{2}$ long: shell thick, coarse, opaque, transversely wrinkled, black on the outside, and often corroded by worms: hinge without lateral teeth, the primary tooth being received into a broad cleft tooth of the opposite hinge.

SOLENS, THE RAZOR-SHEATH.

GENERIC characters, Animal an ascidia; shell bivalve, oblong, open at both ends; hinge with a subulate reflected tooth, often double, and not inserted in the opposite valve. There are 23 species; they have the name of razor-sheath, or knife-handle, from the elongated form of their shells, many of which are very beautiful.

The Linnæan solens are divided by foreign writers into three different genera, two of which comprehend the recent kinds, the third is established chiefly for the reception of some fossil shells, supposed to be of this family. These genera are *Solen*, *Sanguinolaria*, and *Corbula*. The Solens, according to these writers, have the shells transverse, with the upper and lower margins almost straight, with beaks gaping at both extremities; and the two valves together furnish either two or three teeth in the hinge. *Sanguinolaria* differs in having the upper margin curved, the extremities a little gaping, and two approximate teeth in each valve, which lock into each other when the shell is closed. *Corbula* has the valves unequal, subtransverse, and regular, with a conic curved tooth in each valve; the ligament of the hinge within, and the inside of the shell, marked with two muscular impressions.

TELLINA, THE TELLINA.

GENERIC characters, Animal a tethys; shell bivalve,

HELMINTHOLOGY.

Plate IV.





Testaceous or Shell Worms.

London Published August 25, 1808, by J. Waller.

J. Chapman sc.

valve, generally sloping on one side; in the fore-part of one valve a convex, of the other a concave, fold; hinge with usually three teeth, the lateral ones smooth in one shell. This is a numerous genus, containing ninety-four species, found universally: one of which, the *Tellina radiata*, is valued for its beautiful striated arrangement of cordated furrows and stripes.

CARDIUM, THE COCKLE.

ANIMAL a tethys; shell bivalve, nearly equilateral, equivalve, generally convex, longitudinally ribbed, striate, or grooved, with a toothed margin: hinge with two teeth near the beak, and a larger remote lateral one each side, each locking into the opposite. There are 52 species.

The PRICKLY COCKLE, *Cardium echinatum*.

Shell slightly heart-shaped, with carinate spinous ribs. Inhabits the European seas. White or tawny with white bands; the grooves deep, about eighteen, and wrinkled near the hinge; the prickles growing larger from the middle towards the circumference, and none near the hinge.

This species is delineated on the Helminthology Plate IV. Fig. 1 shows it as placed on its base, with the siphunculi or siphons in front, by which it draws in and squirts out the water, the cirrhi or byssus with which it adheres to extraneous bodies, and the fleshy hook or foot of the animal, in the act of being protruded. Fig. 2, represents the same species with the foot or hook protruded, in order to take its nourishment; and by the help or elastic power of which it can jerk itself from place to place; and in this manner, when it happens to be left by the tide, it regains its proper element. If touched ever so gently when lying in this attitude of evident enjoyment, it withdraws the hook, and closes in the twinkling of an eye. Lobsters and crabs lie in wait for this opportunity

tunity of thrusting in a leg or a claw, whereby they kill and secure the cockle for food; but it often happens that the younger ones of those crustaceous animals, not being sufficiently hardened or matured to withstand the violent snapping of the shells on their close, lose the limb; and herein we see the abundant wisdom and benignity of the Almighty, in having bestowed on the cancer tribe the power of renewing their members when cut off; and, but for which, the whole race would soon become extinct, since this mode of procuring their living subjects them to eternal warfare. Fig. 3, is a fine representation of the same species, as given by Müller, with its top shell taken off, discovering the scythe-like or scythe-shape of the animal, when its body and foot are expanded in action, and in which position it always forms an angle the base of which is the foot, whence some naturalists have described the animal as pediform. The whole is a carneous rounded body, issuing from among the membranes and lamellæ, which have their origin near the hinge. This is secured by two strong teeth near the beak, and a remote lateral one on each side, locking securely into each other; these constitute the Linnæan character for ascertaining all shells belonging to this genus. It has a most beautiful and delicate membrane, which lines the interior of both the valves, edged with a fine orange-colour fimbriæ, completely inclosing the animal when at rest, and by the action or play of which the valves are unquestionably opened and shut. In this membrane, likewise, the cirrhi or holders have their origin; and to its base the ovarium is secured.

MACTRA, THE PELLUCID OYSTER.

ANIMAL a tethys: shell bivalve, unequal-sided, equivalve; middle tooth of the hinge complicated, with a small hollow each side, lateral ones remote and inserted into each other.—There are 27 species, several

OF TESTACEOUS WORMS. 573

veral of which have a shell so thin as to resemble paper.

DONAX, THE FLAT-SIDED COCKLE.

ANIMAL a tethys; shell bivalve, with generally a crenulate margin, the frontal margin very obtuse: hinge with two teeth, and a single marginal one placed a little behind. There are 19 species.

VENUS, THE VENUS.

ANIMAL a tethys: shell bivalve, the frontal margin flattened with incumbent lips; hinge with three teeth, all of them approximate, the lateral ones divergent at the tip. This is an extensive genus, containing 154 individuals; the shells of which are in great request with conchologists. One of the most valued is the *Venus Dione*.

SPONDYLUS, THE THORNY OYSTER.

ANIMAL a tethys; shell hard, solid, with unequal valves; one of the valves convex, the other rather flat: hinge with two recurved teeth separated by a small hollow,—There are but 4 species.

CHAMA, THE CHAMA.

GENERIC characters, Animal a tethys: shell bivalve, rather coarse; hinge with a callous gibbosity, obliquely inserted in an oblique hollow: anterior slope closed. There are 25 species, which vary surprisingly in size; some being remarkably small, while others, and particularly the *Chama gigas*, is sometimes of such an astonishing capacity as to weigh five hundred and thirty-two pounds, and the inhabitant is so large as to supply a dinner for one hundred and twenty people; and is strong enough to snap off a man's leg or arm by the closing of its shells, which it can open and shut with great celerity.

ARCA,

ARCA, THE CHEST OR BOAT WORM.

GENERIC characters, Animal a tethys; shell bivalve, equivalve; hinge with numerous sharp teeth, alternately inserted between each other.—There are 43 species; they are considered curious, the shells being fashioned like a boat, or the keel of a ship; the most valued and scarce is called *Arca Noë*, or Noah's ark.

OSTREA, THE OYSTER.

GENERIC characters, Animal a tethys; shell bivalve, generally with unequal valves, and slightly eared; hinge without teeth, but furnished with an ovate hollow, and mostly lateral transverse grooves: thus they are immediately distinguished from the genus *Arca*, in not having teeth alternately locking in each other.

This genus comprehends the two extensive families of pectens or scallops, and oysters; and there are no less than a hundred and thirty-six species in the whole. In both divisions, the animal is well known as a nutritive and valuable food. Both scallops and oysters are found plentifully in the Indian Seas, the Mediterranean, the American Ocean, and in the European seas, where they constitute a considerable article of commerce. The scallops grow a sort of coarse byssus; and have the agility of leaping full half a yard out of the sea, at which time they open their shells, and spout out the stale water within them; after which they rapidly sink, taking in fresh water, and closing their shells with a loud snap, which betrays their beds to the watchful fisherman. These shells, *Ostrea maxima*, were formerly worn by pilgrims on the hat or mantle, as a token that they had crossed the seas in order to pay their devotions to the sacred reliques in the Holy Land; in commemoration of which,

which, scallop-shells are borne in the arms of many ancient families.

The difference between the oyster and the scallop is so obviously impressed by the hand of nature on the respective shells which compose them, that few writers on this subject have passed silently over the impropriety of thus placing them together. The scallop differs from the oyster in being endowed with a higher locomotive power: the animal is different in having the branchiæ cirrhatèd, or fringed; in being furnished with a kind of foot, like the *Cardium echinatum*, delineated in the Helminthology Plate IV. fig. 2, which it protrudes from the shell near the auricle of the hinge; and in throwing out a byssus similar to the pinna and the muscle, by which it fixes itself to other bodies. Aristotle, and other ancient writers, attribute to the scallop the power of springing from place to place on the sea-shore. Argenville describes its movements both in the water and out; he relates, that when left dry, by a sudden closing of its valves, assisted by the foot, it has the power of springing four or five inches at a jerk, repeating this motion in order to regain its element. "In the water, (he says,) it has the power of rising and sustaining itself near the surface, turning about in various directions, and on any alarm suddenly closing the valves and sinking to the bottom.—The oyster, on the contrary, has the branchiæ simple, and not fringed, and is unfurnished either with a foot or with byssus; and its powers of motion consist in turning either the flat or convex side upwards or downwards; and even to effect this, the animal is said to take advantage of the force of the ebbing or flowing of the water to assist it." Yet, still, in the articulation of the hinge the generic character holds good.

Fig. 8, in the same Plate IV. is the *Ostrea fuci*, or sea-weed scallop, the *Pecten striatus* of Muller; a small species, generally found among fuci or sea-weeds.

weeds. It is here delineated in the act of fixing itself by its filaments or byssus to some extraneous body, its siphunculus exerted, and its fimbriæ expanding for the purposes of nutrition. Fig. 9, shows the valves laid open, to demonstrate the internal structure of the animal, which is represented in a retractile quiescent state, the byssus crisped up, the carneous body, ligula, and fimbriæ, contracted and at rest; and the ovarium of a splendid red, partly covered with a delicate membrane. From the ovarium the young are excluded completely formed; and by the help of a magnifier, the joinings of the little infant shells can be distinctly seen, with all their parts as perfect as the parent animal, though appearing to the naked eye only as a minute point.

ANOMIA, THE ANOMIA.

GENERIC characters, Animal an emarginate ciliate strap-shaped worm, with bristles or fringe affixed to the upper-valve; arms two, linear longer than the body, connivent projecting, alternate on the valve and ciliate each side, the fringe affixed to each valve: shell bivalve, one of the valves flattish, the other gibbous at the base, with a produced beak, generally curved over the hinge; one of the valves often perforated near the base: hinge with a linear prominent cicatrix and a lateral tooth placed within, but in the flat valve on the very margin: two bony rays for the base of the animal.—There are 51 species, of many different sizes and forms, some measuring six or seven inches over. Only two species are known to inhabit the British seas, viz. 1. The *ephippium*, with the habit of an oyster; the one side convex, the other flat; perforated; adherent to both bodies, often to oyster-shells, by a strong tendinous ligature; colour of the inside perlaceous. Size, near two inches diameter.— 2. The *squamula*, with shells resembling the scales of fish; very delicate and silvery; much flattened; perforated;

forated; very small. Adheres to oysters, crabs, lobsters, and shells.

The species of this genus are commonly called *beaked cockles*. No name has been given to the fish that inhabit it; for the recent shells of this kind are so very rare, that there is scarcely one to be found perfect. They are, perhaps, for the most part inhabitants of the deepest part of the ocean; consequently it must be some extraordinary agitation of that great body of water that can bring them at all to our knowledge in their recent state. The fossil species of the *anomia* genus are uncommonly numerous in this island, in our chalk-pits and limestone-quarries; and, in Gloucestershire, they are as common on the ploughed lands as pebbles in other places.

MYTILUS, THE MUSSEL.

ANIMAL allied to an ascidia: shell bivalve, rough, generally fixed by a byssus or beard of silky filaments; hinge mostly without teeth, with generally a subulate excavated longitudinal line. There are 64 species; some of which are valuable as producing the true mother of pearl, others as food.

In the Helminthology Plate IV. fig. 6 represents the *Mytilus pholadis*, a very curious species of mussel, in the act of opening its valves to take its food, and of throwing out its subulate foot or spine, and the byssus or threads with which it adheres to extraneous bodies. Fig. 7 displays the same animal fully expanded; its foot or hook projected, and its byssus or beard of silky filaments crisped up, as it always appears when not attached or sticking to any foreign body. The trunk or siphon of this animal is divided into two tubes or orifices at its extremity, which are its mouths, of a bright red colour, and finely ciliated; the body is carneous, of a whitish yellow colour, and when swollen out appears to be too large for its shell. It inhabits the North Seas.

PINNA, THE NACRE.

THIS is the last genus of the bivalves; and its species appear to form the link between this division and the univalves; the shell is gaping at one end, and the valves are without a hinge, and united, at the other: so that it is not strictly a bivalve, being thus connected. The animal is a limax or slug; and there are eighteen species, all of which produce a delicate kind of byssus, which is woven into silk, and highly prized by the Italian ladies. The flesh of many of them is a very rich food. They are found abundantly in the Adriatic, Mediterranean, and Indian, seas; and also in the American Ocean.

ARGONAUTA, THE ARGONAUT.

WE are now arrived at the worms with univalve shells, the inhabitants of which, possessing a less complex arrangement of parts, are more simple in their nature, as well as in the structure of their dwellings. The generic characters of the Argonauta are simply these, Animal a sepia or a clio; shell univalve, spiral, involute, membranaceous, one-celled. There are only 5 species.

The PAPER NAUTILUS, *A. Argo*.

So called from the thinness of its shell: keel or ridge of the shell toothed on each side. Shell white or yellowish, with knotty striæ or ribs, which are sometimes forked; the keel generally greenish brown. It inhabits the Mediterranean sea, and Indian Ocean; and from the thinness of its shell, is called the *paper nautilus*. This is the famous nautilus, supposed, in the early stages of society, to have first taught men the use of sails. When it means to sail, it discharges a quantity of water, by which it was made heavier than the sea-water, and, rising to the surface, erects its arms, and throws out a membrane between them, by which

OF TESTACEOUS WORMS. 579

which means it is driven forwards like a vessel under sail; two of the arms it hangs over the shell, to serve as oars or as a rudder.

NAUTILUS, THE NAUTILUS.

GENERIC characters, Shell univalve, divided into several departments communicating with each other by an aperture.

This genus contains the most beautiful of all shells. It consists of thirty-one species, several of which are found fossil, particularly the species called *belemnita*; which in England received anciently the name of *thunderstone*, from a notion that they are thunderbolts, and generally to be found after a storm. Modern improvements in natural history and mineralogy have completely removed these vulgar errors. Many small species of nautilus are found on the shores of Great Britain.

CONUS, THE CONE.

GENERIC characters, Animal a limax, or slug; shell univalve, convolute, turbate; aperture effuse, longitudinal, linear, without teeth, entire at the base; pillar smooth. This is a very extensive genus, comprehending the families of univalve shells of an oblong conical figure, with truncate or gibbous base. Many rich and diversified colours, displayed with a regularity and beauty far beyond the ingenuity of man, have contributed to render some of these shells of incredible value in collections. There are seventy-two species, besides many varieties; some of which have been dignified with splendid names by conocho- logists; such as *cedo nulli*, imperial crowns, tulips, admirals, &c. None of these elegant shells are ever found on the coasts of Britain; they are chiefly inhabitants of the Asiatic and African seas, and seem to derive their splendour, like birds, &c. from the warmth of the climate.

CYPRÆA, THE COWRY.

GENERIC characters, Animal a slug: shell univalve, involute, subovate, smooth, obtuse at each end; aperture effuse at each end, linear, extending the whole length of the shell, and toothed on each side.—There are no less than 120 species now ascertained by Dr. Gmelin. The shells are commonly called *cowries*, or *gowries*; and that species in particular called *Cypræa moneta*, is fished up principally by the negro-women, three days before and after the full moon, and transmitted into India, South America, and the adjacent islands, where they are used in commerce, instead of small money. They inhabit principally the Mediterranean, Atlantic, and Ethiopic, oceans, and the Indian seas.

BULLA, THE DIPPER.

GENERIC characters, Animal a limax: shell univalve convolute, unarmed with teeth: aperture a little straitened, oblong, longitudinal, very entire at the base: pillar oblique smooth.—This genus differs principally from *Cypræa*, in not having the lips toothed, but smooth or plain. The animal is a slug; and there are 52 species. Several, which have been dissected, are found to be provided with a stomach, or organ very similar to the gizzard of a fowl, and in which were found divers small shells with the animals alive in them, and even a young one of its own genus, partly triturated; so that the bullæ appear to feed on the smaller shell-animals, which they swallow down alive, and, after trituration, return the shells by the same mouth or orifice which takes them in, like many of the mollusca order.

Fig. 13, Helminthology Plate IV. represents that curious species called *Bulla akera*, of its natural size. It is shown, first standing on its base, with the back of the shell in front; and secondly, lying prostrate, with

with the little animal in its quiescent posture. In form, it has the exact resemblance of a hydatid, its body a gelatinous or membranaceous vesicle, appended to a small neck and head, with transparent globules, filling the abdomen like young *tænia hydatigena*. This is evidently the ovarium, filled with ovula in an advanced state. The animal is of an ashy-brown colour; its body is marked with brown channels, and truncated on the fore-part; it protrudes from a large gelatinous mass, as if coming out of a sheath. The eyes are like two black points at a distance from each other in the fore-part of the body; and there is not the least indication of feelers. The margin of the body is sometimes so bent as to have some resemblance to an ear. The gelatinous mass, with which the hind-part of the snail is surrounded, is numerously spotted with brown. A small pellucid and thin membrane seems to cover the outside of the shell, and another membrane to clothe the inside; this gives the shell, when the animal is in it, a reticulated appearance on the outside, of a brown colour with pale specks. The animal, when put in a dry place, does not, like the testaceous fish, retire into its shell, but, with the gelatinous mass above-mentioned, remains out of the shell, which is scarcely capacious enough to contain the whole. Müller observed it among the fuci, or sea-weed, of the Kragaer rocks, on the coast of Norway.

VOLUTA, THE VOLUTE, OR MITRE.

THIS is a most extensive genus, comprising the one-celled spiral shells without a beak, with plaited pillar, and generally without lips; and though the humble inhabitant is nothing more than a slug, yet the shells, at least many of them, such as the mitres, papal crowns, &c. rank high in every choice collection, and are consequently of a great price. There are no less than a hundred and forty-four species,
which

which principally inhabit the Indian Seas; though some of the inferior kinds are found on many of the European and American coasts.

BUCCINUM, THE WHELK.

A VERY copious genus, comprehending all those animals whose shells have an ovate aperture, terminating in a short canal, *leaning to the right*, with a retuse beak, and the inner lip expanded. There are no less than 198 species, formed into eight divisions or families; among which are included the tuns, calques, harps, whelks, partridges, &c. of different conchologists; some of which have been highly prized. The included animal is a limax.

The *Buccinum undatum* is exhibited on the Helminthology Plate IV. fig. 11, in its natural creeping posture, with the body wholly protruded, and the limax carrying its shell upon its back. The operculum is a striate horny shield affixed to its tail; and, when the animal retires to a quiescent state, the extremity of the tail laps over the head, and then the shield or operculum exactly closes the aperture of the shell. At *a*, just above the canal or siphon, is shown three of its ovula or eggs. This is an inhabitant of the European seas, and is regarded as a fine specimen.

STROMBUS, THE STROMBUS.

THIS is a genus of turbinated or spiral-shelled worms, with the aperture considerably dilated; but the canal or gutter, contrary to the preceding genus, *leans toward the left*; which is its principal generic character in the Linnæan classification. The *alata*, or winged shells of conchologists, viz. such as have the right margin or lip expanded in a wing-like shape with age, are all included in this genus; as are a great number of the rocks or murices of the ancients. In this genus the animal is a limax; and there are fifty-three species.

Fig.

Fig. 12, in the above Plate IV. exhibits that curious univalve shell, called *Strombus pes pelicanus*, the pelican's or corvora's foot, with the limax advancing from it, having its head and tail already put forth, and its horny operculum adhering to the posterior extremity, as in the preceding genus. It is an inhabitant of the European and American seas; and the shell is valuable.

MUREX, THE MUREX.

GENERIC characters, Animal a limax: shell spiral, rough with membranaceous sutures; aperture oval, ending in an entire straight or slightly ascending canal.—There are 182 species, divided into six sections.

TROCHUS, THE TROCHUS.

GENERIC characters, Animal a limax; shell spiral, more or less conic; aperture somewhat rounded, the upper side transverse and contracted; pillar placed obliquely.—This genus contains 133 species, many of them exceedingly beautiful; and divided into three classes or families, according to the form or character of their shells, viz. 1. Umbilical, erect, with the pillar perforated. 2. Imperforate, erect, with the umbilicus or navel closed. 3. Tapering, with an exerted pillar, and falling on one side when set upon the base: these are named by some conchologists, *pyramidella*, or pyramidal shells.

Belonging to the first division is the species shown at fig. 14 of the Helminthology Plate IV. It is the *Trochus cinerarius*, turned on its back, with its head and horns protruding, and its body drawn within the shell, while its feet, and the horny margin of its belly, form an orbicular shield or operculum over the aperture. Fig. 15 shows the same animal wholly extended from its shell, with the tentacula exerted. This species is ranged in the first division of the trochi,

chi, is seldom larger than a pea, and is found on all our shores.

TURBO, THE WREATH.

THE shells belonging to some of the animals of this class are of prodigious value. Many of them appear to be closely allied to the *Buccinum* genus; but are readily distinguished by attending to the Linnæan generic characters, viz. "Spiral solid; aperture orbicular, and contracted." The animal is a limax; and the number of species amounts to 151, which are arranged in five distinct families, according to the similitude of their shells. 1. Those with the pillar-margin of the aperture dilated, and imperforate; as the *Turbo littoreus*, or common periwinkle. 2. Solid, and imperforate. 3. Solid, and umbilicated or perforated. 4. Cancellated; as in that rare species called *Turbo scalaris*, the wentle-trap; a shell in great estimation. 5. Tapering. One small species of this genus is exhibited on the Helminthology Plate IV. fig. 16. with the animal advancing in its natural creeping posture, bearing the shell tied by a membrane to its back, as is the case with nearly all the univalve tribe, just as we see exemplified in our common garden-snail.

HELIX, THE SNAIL.

GENERIC characters, Shell univalve, spiral, sub-diaphanous, brittle; aperture contracted, semilunar or roundish.

Though the snail is one of the most humble of the testaceous tribes, yet its family is very abundant; and the shells of some individuals are extremely curious and beautiful, and are prized. The snail appears to inhabit every part of the world, both on land and in the water. Some frequent gardens and woods, rocks and mountains, and beds of sand; whilst others prefer the depths of the ocean, fresh-water rivers, lakes,

lakes, and ponds. Their sizes are no less various than the countries and places in which they are found. They fill up all the intermediate sizes, from that of an apple or an egg to the minuteness of a grain of wheat; and in that diversity of size, exhibit all the colours of the rainbow, with the polish of ivory or marble. There are no less than 267 species now ascertained, which are classed in five divisions.

The eyes of the snail are lodged in their horns, one at the end of each horn, which they can protrude and retract at pleasure. The manner of examining their eyes, which are four in number, is this: when the horns are out, cut off nimbly the extremity of one of them; and, placing it under the microscope, we discover the black spot at the end to be really a semiglobular eye. The dissection of this animal is very curious: the microscope not only discovers the heart beating just against the round hole near the neck, which seems the place of respiration, but also the liver, spleen, stomach, and intestines, with the veins, arteries, mouth, and teeth, are plainly observable. The intestines are green; and are branched all over with fine capillary white veins: the mouth is like that of a hare, with four or six needle-teeth, resembling hose of leeches, and of a substance like horn. Snails are all hermaphrodites, having both sexes united in each individual. They lay their eggs with great care in the earth, and the young ones are hatched with shells completely formed. Snails discharge their excrements at a hole in their neck; they also breathe by this hole, and their parts of generation are situated near it. They bring forth their eggs by the aperture of their neck. So small an animal as the snail is not free from the plague of supporting other smaller animals on its body; and as in other animals we find these secondary ones either living on their surface as insects, or in the intestines, as worms, so it is very remarkable that the snail is infested in both these ways.

Snails are great destroyers of wall fruit. Lime and ashes sprinkled on the ground where they most resort will drive them away, and destroy the young brood of them : it is a common practice to pull off the fruit they have bitten ; but this should never be done, for they will touch no other till they have wholly eaten up this if it be left for them ; and their instinct is wonderful, that they know exactly where to return to it.

Among the many peculiarities of these animals, the mode by which they conduct their amours is the most curious and surprizing ; at this season they make their approaches by discharging several small darts at each other, which are of a sharp form and of a horny substance. These are contained within a cavity on the right side of the neck, and are launched at each other, with some degree of force, at about the distance of two inches, till the quiver or reservoir is exhausted, and then a reconciliation takes place, and the animals unite. The eggs are perfectly round, and about the size of small pease.

The ESCULENT SNAIL, *Helix pomatia*.

Specific character, shell subumbilicate, subovate, obtuse, with a roundish semilunar aperture ; reddish-brown with obsolete paler bands. Inhabits the woods of Europe, and was introduced into England by Sir Kenelm Digby, for medical purposes ; principally for consumptive and emaciated habits. This snail is used as an article of food in France, Italy, and Spain, during Lent ; being preserved in an *escargatoire*, a large place boarded in, with a floor covered half a foot deep with herbs, in which the snails nestle and fatten. They were also a favourite dish with the Romans, who had their *cochlearia*, a nursery similar to the above. Fulvius Hirpinus was the first inventor of this luxury, a little before the civil wars between Cæsar and Pompey. The snails were fed with bran
and

and sodden wine. If we could credit Varro, they grew so large, that the shells of some would hold ten quarts! People need not admire the temperance of the supper of the younger Pliny, which consisted of only a lettuce apiece, three snails, two eggs, a barley-cake, sweet wine, and snow, in case his snails bore any proportion in size to those of Hirpinus. Its name *pomatia* is rived not from any thing relating to an orchard, but from *πωμα*, an operculum, it having a very strong one. This seems to be the species described by Pliny, lib. viii. c. 39. which he says was scarce; that it covered itself with the opercle, and lodged under ground; and that they were at first found only about the Maritime Alps, and more lately near Velitræ.

The VIVIPAROUS SNAIL, *Helix vivipara*.

We have said that the snails are in general oviparous. There are, however, a few species of the viviparous kind; one of which we shall illustrate, as being highly curious. Fig. 10, in the Helminthology Plate IV. is a correct representation of the viviparous snail, as given by Müller, in the act of parturition. The head of the parent-snail is seen emerged from the shell, just far enough for the orifice in the side of its neck (called in all these vermicular tribes, the *lateral pore*) to protrude the sexual organ charged with its young, one of which is shown advancing into life, completely formed; and, so soon as its young are delivered, the membrane or womb is redrawn within the pore. The shell is very white, with three brown bands shaded with yellow; the snail is red. In some varieties (particularly in that described by Linnæus, β) the shell is more shining and glossy, and the included animal of a blackish colour.

NERITA, THE NERITE.

THIS is a genus in which the species are in shape and form not far removed from the helices; yet so as

to be very distinguishable on a slight view. The animal is a limax; shell spiral, gibbous, flattish at bottom; aperture semilunar; pillar-lip transversely truncate, flattish.—There are seventy-six species, which are subdivided into three tribes or classes, according to the fashion of their shells. 1. Umbilicate; aperture semi-orbicular or semi-lunar. 2. Imperforate, lip smooth or toothless. 3. Imperforate, with the lip dentated.

HALIOTIS, THE SEA-EAR.

GENERIC characters, Shell univalve, dilated, ear-shaped, with a longitudinal row of orifices along the surface; spire lateral, and nearly concealed. The animal is a limax, included in an ear-shaped shell; whence the name. There are only nineteen species at present known. Some conchologists admit it as a collateral character of the Haliotis, that the inside is always of the finest pearl, and pearls are oftentimes produced in these shells. The perforations vary in number in different species. It has been observed, that the animal always closes one of those holes towards the spire, whenever he opens another towards the head, as he grows bigger; and by that means the number of openings invariably is the same in different individuals of the same species. Shells of this genus are very rarely discovered fossil; and it is to be doubted whether any of those described by writers are truly of this genus.

PATELLA, THE LIMPET.

GENERIC characters, Animal a limax, or slug; shell subconic, shaped like a basin, and without a spire.—There are no less than 240 species. They are named from their resemblance to a little plate, (*patella*,) and are more or less conic without, and concave within. Some species have the apex or top entire; others perforated; the chambered limpets are distinguished

guished by a peculiar kind of projecting process, or lip, within; most have the margins entire, but some have an indent or fissure in that part; and others are so completely spiral or wreathed in their exterior appearance, that they resemble rather the trochi, or top-shells, than the limpet. They are arranged in five distinct sections or families, viz. 1. Labiatæ, furnished with an internal lip; shell entire. 2. Dentatæ, with the margin angulated, and toothed. 3. Mucronatæ, with the pointed tip recurved. 4. Integerrimæ, very entire, and not pointed at the tip. 5. Perforatæ, with the crown perforated.

The ANOMALOUS LIMPET, *Patella anomala*.

A very singular species. The animal possessing the limpet-shell is said to be a limax; but this individual differs from all others, either of its own or of other genera. This animal is formed of two tough spirally-twisted reddish lobes, fringed round the whole length, the fringes consisting of bluish rigid crisp hairs or filaments, united to the lobes by a blue tendon: the ovaries consist of two vascular bodies, foliaceous or branched, and of an orange colour; the ovula are globular, and of a whitish grey while in the ovarium; purple when first excluded, and orange when the young are fit for bursting into life. This species is shown on the Helminthology Plate IV. fig. 17. The foliated ovaries, with three of the eggs, are correctly exhibited at *b*. In its natural state it is about the size of a silver penny; but is here considerably magnified in order to distinguish its singular construction.

DENTALIUM, THE TOOTH-SHELL.

GENERIC characters, Animal a terebella: shell univalve, tubular, straight, or slightly curved, with the cavity undivided and open at both ends.—Gmelin enumerates 21 species, either recent or fossil, distinguished by the angles, striæ, or form, of their shells.

SERPULA,

SERPULA, THE SERPULA.

GENERIC characters, Animal a terebella; shell tubular, and generally adhering in clusters to other substances; often separated internally by divisions at uncertain distances.—There are 48 species.

The SPIRAL SERPULA, *S. spirorbis*.

Shell regular, spiral, orbicular, delicately white, and spirally contorted, growing less towards the centre. The animal is furnished with an elongated proboscis or sucker, enlarged at the extremity into a cup-shaped mouth, white externally, and deep red internally, which it can advance and withdraw at pleasure. The head is likewise furnished with six pinnated or branched tentacula, which it throws out to secure its food, and draws wholly within the shell when at rest, the aperture of which is closed by the cup-shaped extremity of the proboscis, which then serves as an orbicular shield or operculum. This species is shown on Plate IV. fig. 18, very much magnified, to exhibit its beautiful structure; and at fig. 19 is a group of these minute animals in their natural state and size, as found attached to the fronds of different species of fuci, which have then the appearance of being ornamented with silver spangles.

TEREDO, THE SHIP-WORM.

GENERIC characters, Animal a terebella, furnished with two calcareous hemispherical valves, truncated before, and two others of a lanceolate form, penetrating wood. This is a terebella of a peculiar kind; the body being of a soft and gelatinous nature, but having the head provided with an instrument of a calcareous substance, which performs the office of an auger, and penetrates the hardest oak. The most destructive of the genus is the *Teredo navalis*, which perforates the bottoms of ships, and renders the invention
of

of coppering the bottoms highly expedient. These worms were originally imported from India into Europe, about seventy years ago.—Three species only of this singular genus have yet been discovered, and which are named *navalis*, *utriculus*, and *clava*.

SABELLA, THE SAND-WORM.

THIS is the last genus of testaceous worms, and appears to be the connecting link between this order and the Zoophytes, among which Ellis placed it. The animal is a nereis, with ringent mouth, and two thickish tentacula behind the head: the shell is tubular, composed of particles of sand, broken pieces of shell, and sea-weed, united to a membrane by a kind of glutinous cement; whence it has very much the resemblance of a coralline. There are twenty-five species now ascertained; one of which, *Sabella alveolata*, is correctly delineated in the Helminthology Plate IV. fig. 20. It is found in considerable masses of a tubular construction, and of the appearance of honeycomb, adhering to the bottoms of rocks, on the British coasts, and on all the European shores. Every tube is furnished with an inhabitant; and as they increase in size, they enlarge the capacity of their tubes, and consequently of the mass of materials which contains them. They grow from two to three inches in length, and are oviparous. The animal is furnished on the head with a double row of tentacula, down the centre of which is its longitudinal mouth; the whole bordered with a larger series, and of a pearl-like polish. These are all moveable at the will of the animal, in different directions, and for the purposes of its sustentation. It has six cirrhatid fins or feet, three on each side, whereby it moves itself forward in its tube; and as it advances, it forms to itself a new crust or shell. About the centre of the abdomen is placed a circular body, which is the matrix or ovarium, whence the eggs are excluded, adhering to the
parent

parent animal till they emerge into life, when they are excluded at the mouth of the tube to form new habitations or combs for themselves.

ORDER IV. ZOOPHYTES, OR PLANT-LIKE WORMS.

THIS order seems destined by nature to connect the animal with the vegetable life; and hence the individuals classed under this arrangement, have been occasionally denominated the *last* of animals, and the *first* of plants. Most of them take root, as it were, and grow up into stems; multiplying life in their branches and deciduous buds, and in the transformation of their animated blossoms or polypes, which are endued with spontaneous motion. Plants therefore resemble zoophytes, but are destitute of animation, and the power of locomotion; and zoophytes are as it were plants, but furnished with sensation, and the organs of spontaneous motion.—The genera are fifteen in number; of which the two which are most sought after as affording the fine red and black coral, are *Isis* and *Gorgonia*; and these constitute a valuable source of commerce. Next to them are the *Tubipora*, *Madrepora*, *Millepora*, and *Tellepora*, which produce the white coral; and are denominated *lithophyta*, because in these the coral or bone of the animal is external or naked; whereas in the other genera it is clothed with a fleshy epidermis, or bark.

The season for fishing coral is from April to July; the places are the Persian Gulf, the Red Sea, coasts of Africa, the isles of Majorca and Corsica, and the coasts of Provence and Catalonia, Messina, &c. Spallanzani has particularly described that which is carried on in the strait of Messina. This fishery extends from the entrance of the Faro to the part of the strait opposite to the Church of the Grotto, being a tract six miles in length, and to the distance of three miles from Messina. The rocks which produce the coral

coral are situated almost in the middle of the strait, at different depths, from 350 to 650 feet. The bottom and caverns of the rocks are the places from which they endeavour to bring up the coral with their nets; and it is a constant observation, that every branch is perpendicular to the plane on which it grows, without ever turning on one side.

Coral, it is said, grows more plentifully in places situated to the east than in those to the south; it is rarely found to the west, and never to the north. In the first situation it is generally larger, and of a finer colour, than in the second and third; which two valuable qualities are likewise found in that which is brought from a less depth, compared with that which is fished up much deeper. The greatest height to which it grows is near a foot, and its usual thickness is that of the little finger, and somewhat less than that of the coasts of Trapani and Barbary; but the latter are exceeded by the Messinese in vividness of colour. These differences, according to the account of the fishermen, arise from their coral being produced in a sea which is kept in continual agitation, from the surface to the bottom, by the current and the winds.

The fishermen divide the tract in which they fish into ten parts. Every year they fish only in one of these parts, and do not fish in it again till ten years are elapsed. This interval they think necessary for the coral to acquire its full growth in height and consistence. When they transgress this law, they find the coral smaller, and of less consistence; and the intensity of the colour is always in proportion to the number of years they have desisted from fishing. When the ten years have elapsed, they believe that the coral no more increases in height, but only in thickness; which, however, has its limits. In fact, they have observed, that the coral fished up near San Stefano, a place where none had been sought for in the memory of man, though it was of a very bright colour, was

not higher than the ordinary coral, though it exceeded it by one-third in thickness. The number of ships usually employed in this fishery is eighteen or twenty, each of which is usually managed by eight men. The quantity of coral procured, amounts annually to about twelve Sicilian quintals.

In the cortical and solid parts of the white corals, Spallanzani observes, the orifices of the cells being octo-radiated like those in the red, appears to be a proof that the polypi in both are of the same structure. That coral is soft in the sea, and hardens when it comes in contact with the air, was the opinion of the ancients; but this has been proved fallacious by the observations of the moderns. The coral-fishermen of Messina, who derive all their knowledge from experience only, are convinced this opinion is erroneous; but they assert that coral which has not attained maturity has not that degree of consistence which it acquires when arrived at its full growth. The truth of this position Spallanzani was not able to ascertain, as, for that purpose, it would have been necessary to cast the net in one of those ten parts of the strait in which it is prohibited by the law to fish till the expiration of the ten years prescribed. Yet the rules of analogy, derived from what is observed in all animals and vegetables, incline him to favour this opinion. It is agreed however by the fishermen on the coasts of Barbary, and also by those of Messina, Sardinia, and Corsica, that, the deeper they descend into the sea, the smaller is the coral. Donati observes, that the broken and detached branches of coral, like all polypi, will continue to live and multiply in the sea; which Spallanzani allows to be the case, provided they meet with a firm point of support to which they can attach themselves with their viscous humour. Otherwise, if they fall on the moveable sand, they become the sport of the waves, and he has no doubt but they must perish.

The

The Messinian fishermen appear to be well acquainted with the true generation of coral; and they told Spallanzani that they had frequently observed, on hard substances drawn from the bottom of the sea, the first principles of coral beginning to germinate; which they describe as having the appearance of a red spot, with a button or bud implanted in those matters, evidently the ovum or egg of the parent polype thus deposited; sometimes tender and fragile, and sometimes hardened, and of the colour and nature of ordinary coral. They are likewise acquainted with those branches of coral which, when fished up, are sometimes found perforated by lithophagous worms, mentioned by Vitaliani and Marfigli. Their nets had frequently brought them up, either from the bottom of the sea, from caverns, or the sides of rocks; and these perforated corals were found sometimes broken in the trunk, where the perforations are most frequent; and at other times attached to some body, which served them as a base. They were of opinion that these corals were thus perforated, because they were dry; and this dryness, they imagine, proceeds either from age, or their having been broken from their root by some fish, or by a part of a rock falling on them; or possibly by the coral nets, which do not always bring up all the branches of coral they loosen from their roots.

In order to ascertain the true nature of the substance wherewith corals are formed, and their approximation or affinity to shell and bone, C. Hatchett, esq. F. R. S. has recently subjected several of the genera to chemical investigation. The zoophytes to which his analysis and enquiries were applied, were several species of *Madrepora* and *Millepora*, one species of *Tubipora*, the *Flustra foliacea*, the *Corallina opuntia*, two species of *Isis*, several of *Gorgonia*, two of *Antipathes*, and several of *Sponges*, and also of *Alcyonium*. The first object was to ascertain, in

these animal substances, the presence of carbonat and phosphat of lime, which are the materials employed by nature to communicate rigidity and hardness to shell and bone; and then to examine how the hardening or ossifying principles are secreted and deposited.

The hardening substance of the Madreporæ and Milleporæ (with only one exception,) appears to be carbonat of lime; and they resemble shells in being formed of a membranaceous substance, thus hardened. The only difference is in the mode according to which these materials are employed. The *Tubipora musica* resembles the fore-mentioned substances. With respect to the *Flustra foliacea* and *Corallina opuntia*, only a small portion of phosphat is found, mixed with the carbonat of lime. The *Isis ochracea* and *hippuris* are formed of regularly-organized membranaceous, cartilaginous, and horny, substances; hardened, in the last species, merely by carbonat of lime, and in the former with the addition of a very small portion of phosphat of lime. The hardening substance of the *Gorgonia nobilis* is found to be carbonat of lime, with a small quantity of phosphat; and the matter constituting the membranaceous portion is partly gelatinous, and partly membrane completely formed, so as to cover the stem in the manner of a tube. The other *Gorgoniæ*, viz. the *ceratophytæ*, *flabellum*, *suberosa*, *pectinata*, and *setosa*, are composed of a horny stem, and a cortical substance, by which it is coated. The stems afford a quantity of phosphat of lime, with scarcely any trace of carbonat, and the cortical part consists principally of carbonat of lime, with little or none of the phosphat. The *Antipathes* are found to be little, if at all, different from the horny stems of the *Gorgoniæ*; and the various sponges are completely formed by the same membranaceous or horny substance, varied by modifications of a more delicate construction, rather than by any essential difference in composition. The *Aleyonia* are found to be composed



Loophytes, or, Plant-like Worms.

London, Published at the art press, Sept. 17 1865 by T. Agnew & Sons.



posed of a soft flexible membranaceous substance, similar to the cortical part of the *Gorgonia suberosa*, and in like manner slightly hardened by carbonat, mixed with a small portion of phosphat of lime. From these facts Mr. Hatchett concludes, "that the varieties of bone, shell, coral, and the numerous tribe of zoophytes with which the last are connected, only differ in composition by the nature and quantity of the hardening or ossifying principle, and by the state of the substance with which it is mixed or connected."

Thus, then, it is evident that coral is the bone of zoophytes, analogous to bone in all other animals. But the most surprising circumstance to the natural philosopher is the rapidity with which this material is formed, and the magnitude with which it is presented, in the formation of coral rocks; which rise spontaneously out of the sea, and become by length of time sufficiently capacious to be inhabited by man. Such are the Friendly Islands, and several others in the Indian Ocean.

TUBIPORA, THE TUBIPORE.

GENERIC characters, A coral consisting of erect, hollow, cylindrical, parallel, aggregate, tubes; in which the animal is a nereis. They are of various colours, red, brown, black, white, grey, &c. and grow on rocks, stones, and other hard substances.—Ten species of them have been ascertained.

The Helminthology Plate V. is given to illustrate more satisfactorily the order of Zoophytes.—Fig. 1. represents the *Tubipora serpens*, composed of short rows of circular parallel tubes, of a white or roseate colour, creeping or multiplying upwards; which, in this species, appears to be its mode of generation, till they become deciduous, and fall off at the top, in order to plant or propagate new colonies. This curious species is very minute, being often attached

to the stalks of fuci, and with them washed on shore. In the engraving it is much magnified.

MADREPORA, THE MADREPORE.

THE individuals of this genus are called *white corals*, with lamellate star-shaped cavities. The animal resembles a medusa. There are 118 species, formed into five divisions, depending on the stellated construction of their mouths or pores. They partake of all the light colours, from snow-white to a rosy hue, pale grey, and straw-colour; and are found on the rocks of the Indian Ocean, Mediterranean, Atlantic, Northern, and European, seas.

Fig. 2 of the same Plate is the *Madrepora cristata*, of the natural size, showing its foliaceous construction, with rows of stars impressed in the centre, which are its mouths, and all equally furnished with tentacula. The lamellæ or gills are of a stony hardness, which constitute the coral, formed of the gelatinous matter continually thrown out by the animal, and of which the whole mass is formed. This is commonly found of a pale blue grey, or shining light straw-colour, or white streaked with pale red.

MILLEPORA, THE MILLEPORE.

THIS is also a genus of white corals, in which the animal is a hydra or polype, growing in a branched form, and covered with turbinate pores.—There are thirty-four species, some of which are very beautiful; of various tints, and of a fine polish, appearing as if richly varnished, some with a silver varnish; others with pale yellow or blue-grey. They inhabit the Indian and American seas, the West Indies, Mediterranean and European seas, generally adhering to rocks, or other firm substances.

A specimen of this genus is delineated in the above-mentioned Plate, at fig. 3. It is the *Millepora truncata*, a beautiful white coral, growing erect, with dichotomous

photomous truncate branches, at the ends of which the pores or mouths of the animal are placed. This is often variegated with a tint of yellow or grey, highly polished, and appearing as if varnished.

The common coral of the shops belongs to this genus. It is the *Millepora polymorpha*; and is crustaceous, solid, irregularly shaped, but generally branched and tuberculate, and without visible pores. It inhabits most European seas; and in many places grows in such abundance that it is burnt for manure: its colour is either red, yellowish, or greenish cinereous, but seldom white. Sometimes it is shaped like the kernel of a walnut; often in large compressed masses; sometimes like a small bunch of grapes; but most frequently in short irregular ramifications, of a chalky tuberculate appearance, and stony substance.

The *Millepora alga*, consisting of thin semicircular plates disposed horizontally, inhabits the Cornish coast, adhering to and covering the *polymorpha*, and is either red, purplish, yellow, or whitish: extremely thin and brittle, with semicircular plates of various sizes constantly growing horizontally with their margins bending over, making them convex on the upper side and concave beneath.

CELLEPORA, THE CELLEPORE.

IN this genus the animal is a hydra or polype, of which there are eight species, called likewise *white corals*, though they partake of red, grey, and yellow, tints. They are somewhat membranaceous, and composed of round cells, the mouths of which are margined or fringed with spines or teeth. They inhabit various seas, but principally the Mediterranean.

ISIS, THE RED CORAL.

GENERIC characters, Animal growing in the form of a plant; stem bony and jointed, covered by a soft porous cellular flesh, and the mouths or pores beset with

with oviparous polypes.—This is called by some naturalists the *true coral*. There are only six species, found chiefly in the Indian Seas, round the Spice Islands, at the foot of rocks deeply imbedded in the Ocean, where the fishing for them is attended with considerable difficulty. These are much valued. At fig. 4, Plate V. is a species of red coral, the *Isis coccinea*, of a beautiful branched form, covered with small scarlet prominent cells, occupied by oviparous polypes.

ANTIPATHES, THE DARK CORAL.

ANIMAL growing in the form of a plant; stem expanded at the base, internally horny beset with small spines, externally covered with a gelatinous flesh beset with numerous polype-bearing tubercles.—This genus contains thirteen species, some of which are extremely curious. They are considered as *black corals*, but of an inferior class; the true black coral being a *Gorgonia*. They inhabit the Indian, Mediterranean, and North Seas. One of them is delineated in the Helminthology Plate V. fig. 5. It is the *Antipathes ulex*, a species of black coral, found in the Indian Ocean, of various magnitudes, furnished with numerous ovate yellowish-brown vesicles, lodged upon the branches, and supposed to be the ovaries.

GORGONIA, THE BLACK CORAL.

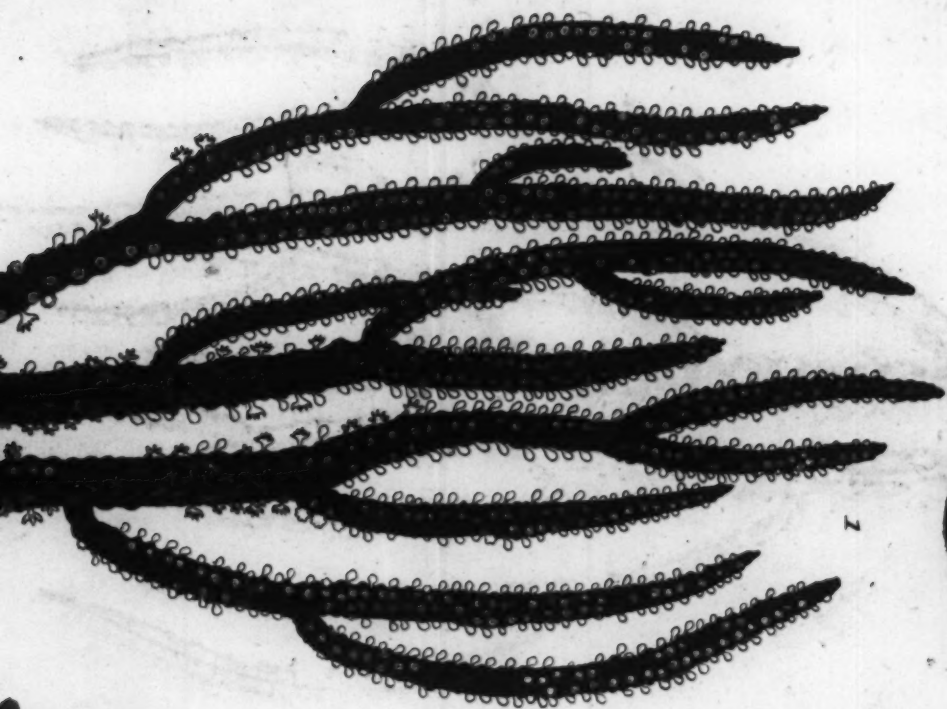
THIS is the most elegant genus in the whole order of zoophytes. It is called *black coral*, as containing the true black coral of the shops; but it includes also some beautiful species of red, white, and brown, corals. The generic characters are—Animal growing in the form of a plant; stem coriaceous, corky, woody, horny, or bony, composed of glassy fibres, striate, tapering, dilated at the base, covered with a vascular or cellular flesh or bark, and becoming spongy and friable when dry, leaving the interior
bone



1. *Gorgonia Verticillata*. 2. *Ides feces magnificed*. 3. *Gorgonia Nobilis*. 4. A branch with its feces magnified.

London Published by the Art Director, March 1786 by J. Miller.

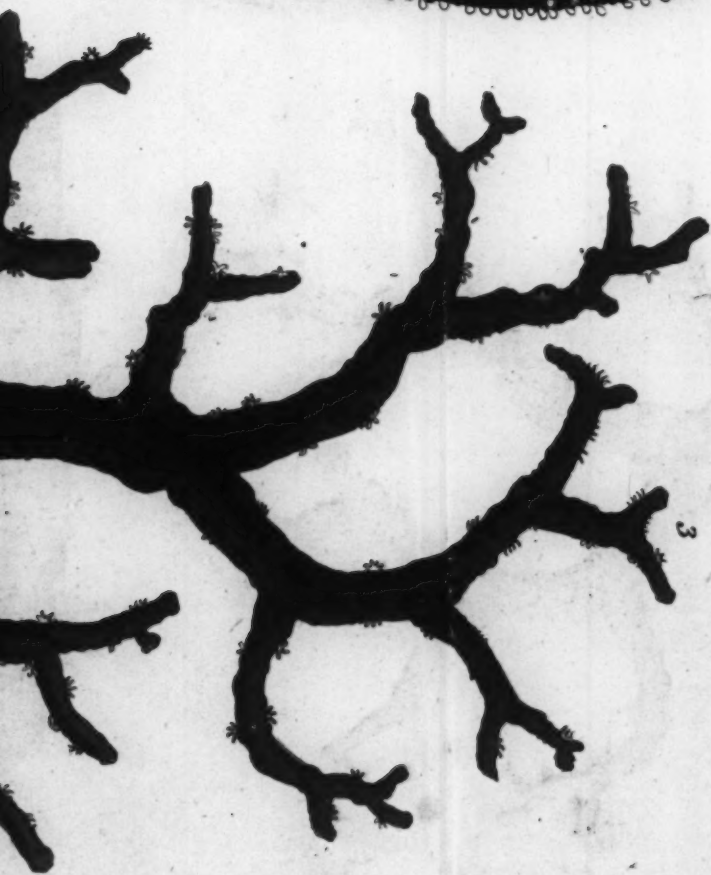
J. Miller sculp.



1



2



3



4

GORGONIA.

Plate I.

Gorgonia Antipathes. 2. Gorgonia Muricata.

London, Published as the Act directs, March 15th 1772.





bone naked, which is the coral; mouths or florets covering the surface of the stem, and polype-bearing. Forty-one species have been ascertained.

The WAXY GORGON, *Gorgonia ceratophyta*.

Grows with branched, divaricate, erect, subdivisions, each marked with two furrows; the polypees or florets are white, placed in irregular rows; flesh purple; bone black, and horny. It is found in the Mediterranean, Atlantic, and South American, Seas; on rocks and ledges, about a foot high. Its bright purple flesh, and silvery polypees, make a most beautiful appearance. See a figure of this in the *Gorgonia* Plate I. fig. 1, and its feelers magnified at fig. 2.

The RED GORGON, *Gorgonia nobilis*,

Irregular slightly-tapering branches; flesh beautifully red, soft, slippery, and full of minute pores; bone stony, and irregularly striate. It is found on coral rocks in the Mediterranean and Red Sea; is very valuable, and grows to about a foot in height; the pores or florets are irregularly placed, and a little prominent, consisting of eight valves, from which proceed the polypees, with eight tentacula, or feelers. See a correct figure of this species in the same engraving, at fig. 3, and a branch of its feelers magnified at fig. 4.

The BLACK CORAL, *Gorgonia antipathes*.

Shrubby, with erect alternate paniced branches; bone with flexuous striæ. Found on the rocks in the Indian and Mediterranean seas; from two to three feet high; horny, deep glossy black, with a grey bark. This affords the most beautiful smooth black coral of the shops; and is represented in the *Gorgonia* Plate II. fig. 1.

The WHITE CORAL, *Gorgonia muricata*.

Round, with depressed subdivided branches; flesh firm, whitish, covered at the ends with cylindrical spinous florets; bone two-edged, blackish. Found on rocks and stones about the shores of the American islands; from two to three feet high; coriaceous, horny, with a white medullary nerve. This is represented in the Gorgonia Plate II. fig. 2.

The WARTY CORAL, *Gorgonia verrucosa*.

Bifarious, with round flexuous branches, and an orange or yellow calcareous bark, covered with white prominent florets, which are the mouths whereby the animal takes in its food. This inhabits the Mediterranean, West Indian, and British, seas, and is found adhering to rocks and stones; sometimes three feet high or more; and grows in a fan-shaped manner; when dry, it is of a dirty-white or cinereous colour; bone of a substance between wood and horn. This is exhibited on the Gorgonia Plate III.

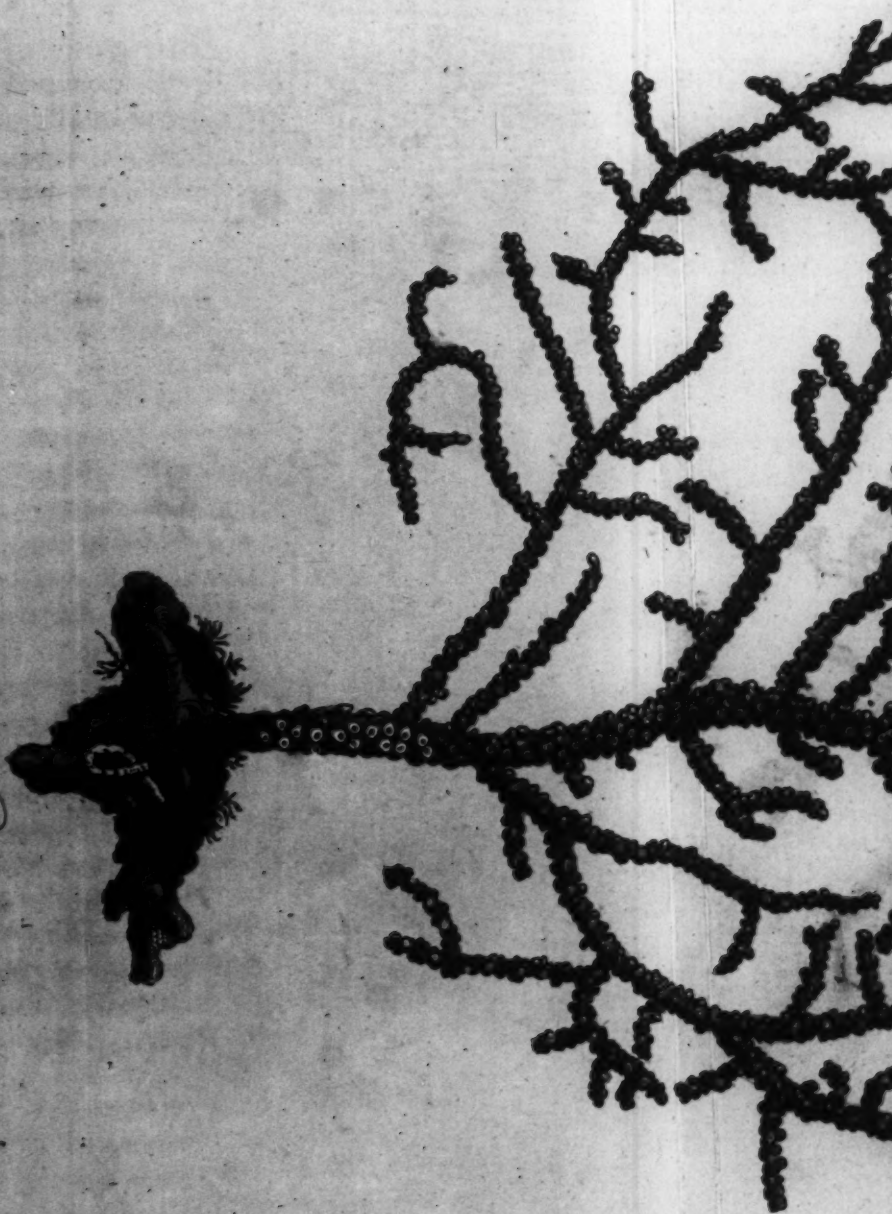
VENUS'S FAN, *Gorgonia flabellum*.

Beautifully and most delicately reticulated, with the branches compressed on the inner side; bark participating of various shades of colours while in a living state; bone blackish, horny, and slightly striate on the larger branches. This inhabits most seas, and is often found several feet high, and expanded into a large fan-shaped surface; it is flexible, horny, and black; the older bark whitish or grey; pores irregularly placed, but generally in the form of a quincunx; trunk and branches pinnate, and by means of the smaller branches blending together, forms an elegant kind of net-work; polypees with eight claws. From the great beauty and delicacy of this species, it has received the name of Venus's Fan; and is correctly figured in the Gorgonia Plate IV.

ALCYONIUM,

John del.

The Porpona Peruviana.
London, Published as the Act directs, June 25. 1741. by J. Miller.



Printed at



3

Gorgonia Strobilum, or Venus's Fan.

London, Published by the Art Director, J. Wilson.



Life size.



GORGONIA.

ALCYONIUM, THE ALCYONIUM.

GENERIC characters, Animal growing in the form of a plant; stem fixed, fleshy, gelatinous, spongy or coriaceous, beset with polype-bearing stellate cells. There are twenty-eight species now ascertained, of various forms and magnitudes; the genus has its name from a supposed resemblance of some of the species to the nest of the *alcyon*, or kingfisher.

The UPRIGHT ALCYONIUM, *A. cydonium*.

This grows in an erect cylindrical form, terminating almost in a point at the top, and covered with innumerable stellate cells, from whence are projected the feelers or tentacula of the animal, when seeking its food. Its colour, in an early state, is chiefly red, slightly tinged with yellow; as it advances to maturity, it becomes of a gold yellow, with bright red under the epidermis. Fig. 1, in the engraving, shows the early state of the animal, with its feelers partly quiescent, partly erected. Fig. 2, the advanced state of the animal, with its feelers protruded, and of the natural size. Fig. 3, represents five sets of the tentacula greatly magnified. Those at *a a*, are extended to catch its food, which it directs to the orifice or mouth in the centre; and at *b b b*, the tentacula or feelers are exhibited at one place as retracting or closing up; at the next, in the act of just putting forth; and in the third place, in a perfectly quiescent state. Found in the Mediterranean and Northern seas.

The LUMP ALCYONIUM, *A. massa*.

This is a smaller species, of an irregular shape, shown in the plate at fig. 4. It is of a reddish colour, with five yellow stellated shells, having black apertures, which are the mouths of the animal. One of these cells, with the feelers extended, is exhibited

at fig. 5, as it appears under the microscope. Found in the sea of Norway.

The RED ALGYONIUM, *A. rubrum*.

Crustaceous, soft; colour carmine, with deeper-coloured scattered dots. This is one of the smallest species at present known; and is likewise an inhabitant of the Norway seas. Fig. 6, shows its natural and quiescent state. Fig. 7, its natural size, with the tentacula protruded. Fig. 8, its quiescent state magnified. Fig. 9, the same, as it beautifully appears under the microscope, with some of its tentacula projected, and others quiescent.

The DEVIL'S CLAW, *A. manus diaboli*.

This is a large and curious species, irregularly shaped, and rising upwards into many smooth obtuse finger-like projections, pointing forwards, and perforated, with stellate tentacula round the orifices, which are the mouths of the animal. This is represented of its natural size at fig. 10. When recently taken, it is of a reddish brown colour. Found on the sea-coast of Iceland.

The SEA FIG, *A. ficus*.

This species is formed of lobes, similar to a pair of lungs, of a dark olive or livid colour, beset with innumerable minute stellate cells of six rays each, distinguishable only under the microscope. It is shown in the plate, of its natural size, at fig. 11; and the rays of the cells magnified, at fig. 12. Mr. Ellis, on dissecting one of these, found it of a fleshy substance; the inside containing numerous little bags of a pale yellow colour, full of a clear viscid liquor; in the midst of which was a small duct leading to the cell or star on the outside. The section is exhibited in the engraving at fig. 13, as it appeared when magnified.

On

On more minutely examining one of these bags separately from the rest, Mr. Ellis discovered several regular figures formed like minute shells, arranged in the inner tube or duct, and placed upon one another. But whether it was the stomach, with the food of the animal, taken in by the orifice or mouth above; or whether it might be the ovarium with its young, he could not determine. This little bag is shown greatly magnified at fig. 14.

The ROUND ALCYONIUM, *A. lyncurium*.

This is shown on the Helminthology Plate V. fig. 6. Specific character, globular, fibrous, tuberculate, yellow. It is a beautiful species, beset with polype-bearing stellate cells. They adhere very firmly to pieces of rock; and are about the colour and size of an unripe orange. Inhabits the Cape of Good Hope.

SPONGIA, THE SPONGE.

THE genus of sponges is not the least curious or interesting. The animal is fixed, flexile, torpid, of various forms, composed of reticulate masses of fibres or spines, covered with a gelatinous flesh, full of small mouths on its surface, by which it absorbs and rejects the water. There are 49 species, which more or less inhabit all seas, growing at the foot of rocks, or stones, or any firm substance. One of the species is delineated in the annexed Engraving, at fig. 7. It is the *Spongia ossiformis*, found adhering to the bases of the Norwegian rocks. This is of a light orange or lemon colour, slightly branched, and thickened round the pores.

FLUSTRA, THE HORN-WRACK, OR SEAMAT.

GENERIC characters, Animal a polype, proceeding from porous cells: stem fixed, foliaceous, membranaceous, consisting of numerous rows of cells united

united together and woven like a mat. It is commonly called Horn-wrack, or Sea-mat. There are eighteen species.

The SEA-MAT, *Flustra chartacea*.

Papyraceous, with cells on both sides, the tops of the branches truncate like the edge of an axe: inhabits the British shores, adhering to shells: of a thin semi-transparent texture, like fine paper, very slight straw-colour: the tops of the branches sometimes digitated, sometimes irregularly divided: cells oblong-square.

The HORN-WRACK, *Flustra verticillata*.

A small species, parasitical, with flattish linear branches, narrowest at the base, and rows of top-shaped ciliate cells disposed in whorls one above another. It inhabits the Mediterranean; adhering to fuci: the cells, when magnified, appear surrounded by sharp denticles, with a long bristle in the front of each, bending inwards like a horn, the mouths incline forwards, and their whole semi-transparent substance appears full of small points.

TUBULARIA, THE TUBULARIA.

GENERIC characters, Animal fixed in a tube, from which it protrudes its tentacula, and withdraws them at pleasure; so that in its quiescent state it has only the appearance of a small dry cylinder. There are twenty-six species now ascertained, which inhabit the rocks in the West Indies, on the shores of America, the Norway and Greenland Seas, the Mediterranean, and Indian Ocean.

The HANDSOME TUBULARIA, *T. magnifica*.

This is a species lately discovered in the West Indies, and by far the largest and most splendid of the genus. Like the rest of its tribe, it has the faculty of drawing

OF PLANT-LIKE WORMS. 607

drawing its tentacula within the tube, and the tube within the rock on which it resides. It seems to connect in some measure the genera Tubularia and Amphitrite, having the annulated wrinkled tube of the former, and the retractile radiated tentacula of the latter. It is most probably oviparous. This species is represented on the Helminthology Plate V. fig. 8. and at *a* is shown another, much smaller, supposed to be a young animal of the same species.

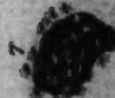
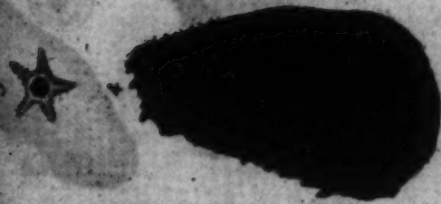
CORALLINA, THE CORALLINE, OR SMALL CORAL.

THIS genus is the smallest of the coral tribe. The characters are, Animal growing in the form of a plant: stem fixed, with calcareous subdivided branches, mostly jointed. There are thirty-eight species now known, which were till of late years supposed to be plants, endued only with vegetable life. Their stems are composed of capillary tubes, whose extremities pass through the calcareous crust, and open into pores on the surface. The branches are always subdivided into smaller branches, which are either loose and unconnected, or joined as if they were glued together. They are distinguished from plants by their texture and hardness; they also yield in distillation a considerable quantity of volatile salt; and their smell, in burning, resembles that of burnt horns and other animal substances. Many of the corallines seem to consist of a single tube, containing a single parent animal. Every branch emitted contains an offspring of this parent dependent upon it, and yet capable of producing its like in the emission of a new branch. Others consist of many such tubes united, rising up together, and encircling the deserted tubes of their progenitors, whose exuviae become the substratum of a rising generation.

This genus has again been very lately insisted upon, by Dr. Pallas and others, to belong entirely to the vegetable

vegetable kingdom, and to differ but little from fucuses and confervas: Linnæus's observation, however, seems quite conclusive to the contrary, in his *Systema Naturæ*, p. 1304. *Corallinas ad regnum animale pertinere ex substantia earum calcarea constat, cum omnem calcem, animalium esse productum verissimum sit*; —“ All calcareous substances are most truly of animal production; therefore corallines, consisting of that substance, do certainly belong to the animal kingdom.” What the precise link is that unites the animal and vegetable kingdoms, no one has yet been able to point out; these corallines, however, appear to come the nearest to it of any production yet known; but the calcareous covering, though ever so thin, shows us that they cannot be vegetables. The white mealy surface of some of the lichens would induce us to think them covered with a calcareous matter: but chemistry shows it is no more of a calcareous nature than the mealy whiteness on the leaves and blossoms of the *auricula urfi*. The minuteness of the pores of corallines, though as small as those of some plants, is no proof of their being vegetables; because there may be suckers that come through these pores, like the pores of sponges, contrived in such a manner as to enable the animal to suck in and throw out the water.

Many of our readers, perhaps, may be desirous of collecting some of the corallines for examination. The greatest variety are to be found on what are generally called rock-oysters, or upon those beds of oysters that have been for some time disused or neglected. Upon such they seem to grow, as it were, in little groves. As soon as they are taken out of the sea, let them be put into sea-water; for the animals are of so delicate a nature, that the air soon shrivels them up. They must be gently pulled from the shells with a pair of pincers, taking hold of them where they adhere to the shells: then put them into white earthen plates full of
clear

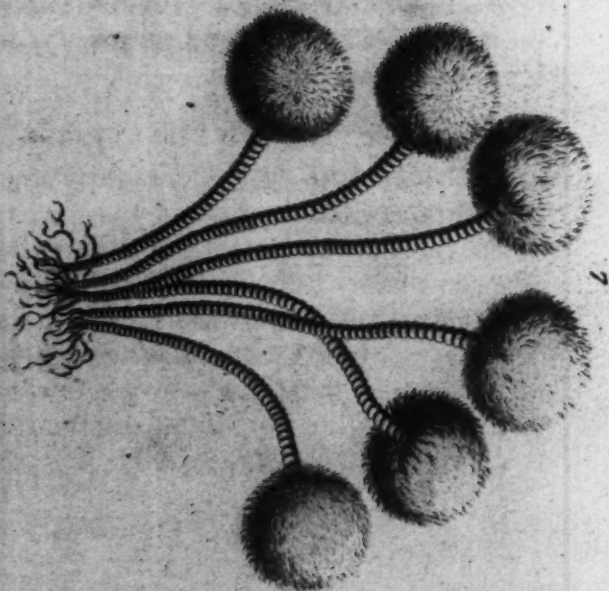
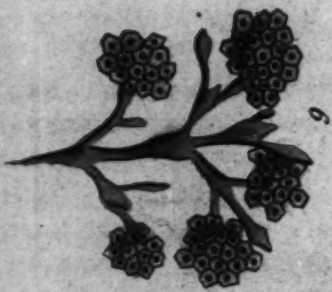
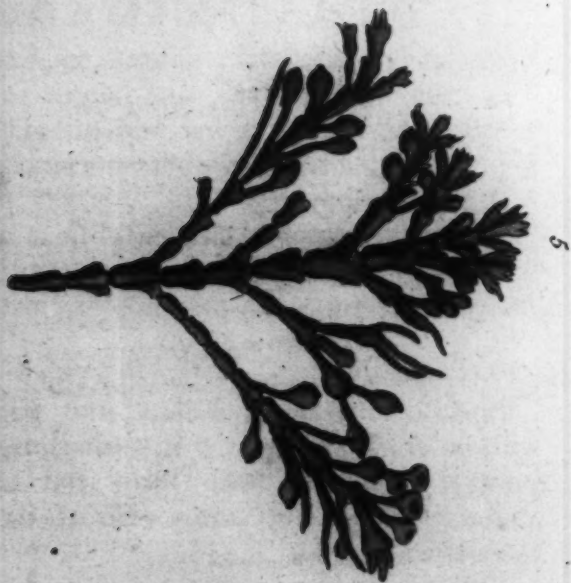
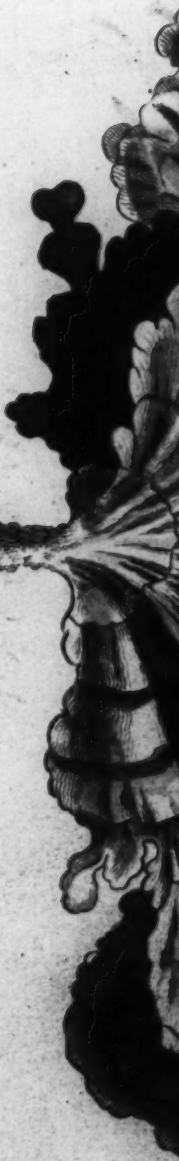




Different Species of Alcyonium?

London: Published at the Art Press, April 13th 1871, by De Witt.

J. De Witt sculp.



Seven curious Species of Corallines.

London: Printed, and sold at the Author's Shop, in Pall-mall, by J. Smith.

CORALLINA.



clear sea-water; and in about an hour, or perhaps less, they will recover, and begin to extend themselves, and will show various incontestible proofs of animal life. For these observations a good magnifier will be necessary.

The annexed engraving exhibits a correct view of seven of the most rare and curious species of coralline; in the following order.

The TRIDENT CORALLINE, *C. tridens*.

Specific character, jointed and trichotomous, or with its branches growing in a division of three; the joints compressed, with three flat lobes. This is abundantly found on the coasts of the North-American islands. Fig. 1.

The CRESTED OR COCK'S-COMB CORALLINE,
C. cristatus.

Specific character, dichotomous, and hair-like, dividing in twos, with rounded joints, having its branches disposed in crested bunches, with ovaries at the last but one and last division. This elegant little coralline is from one inch to an inch and a half long, and most commonly of a beautiful red colour, though sometimes green, and often white. It is found in great quantities about Weymouth and Penzance in the west of England, and generally adheres to the fucus. Fig. 2.

The CONGLUTINATED CORALLINE, *C. conglutinata*.

This hath a single stem, slightly incrustated, with all its branches dichotomous and glued together, but not covered, forming a figure like a fan-shaped leaf. We can plainly distinguish the dichotomous branches of this coralline on its surface, which are each of them separately covered with a thin calcareous substance full of pores; these, by growing so close to one another, become glued or united by their covering. Na-

tive of the Bahama islands; of a sea-green colour, and one inch and a half high. Fig. 3.

The LARGE FAN CORALLINE, *C. flabellum*.

This is the finest species, having a single incrustated stem, with the branches glued together into a leaf, like a fan, covered with a calcareous crust, and somewhat waved. It varies from the figure of a flat kidney-shaped leaf, an inch high, with a broad stalk, to a large subdivided, lobated, undulated, frond-like, figure, five inches high, and as many broad, as delineated in the engraving, at fig. 4. At the bottom of the stalk is a tuft of fine hair-like tubes, by which the animal fixes itself to rocks or stones, like the suckers of an oyster. There are many varieties of this curious coralline brought from the West Indies, of different mixed colours, from a greenish brown to a milk-white.

The GRANIFEROUS CORALLINE, *C. granifera*.

Trichotomous, or branched in threes, with the joints of the stem compressed, and wedge-shaped; those of the branches roundish; from these a series of egg-shaped ovaries with stalks grow opposite to each other, and are sometimes proliferous. This differs from all the other known trichotomous corallines, in having proliferous ovaries, or branches, growing out of them, bearing other ovaries. It is of a beautiful sea-green colour, and slender texture. Native of the coast of Africa, and found in the Mediterranean Sea. This is represented in the Plate at fig. 5. greatly magnified to show the egg-shaped ovaries.

The FLESHY CORALLINE, *C. incrassata*.

Specific character, jointed, with the branches trichotomous, or divided into three, with compressed, plano-convex, wedge-shaped, joints, of a flesh colour.

lour. Found on the shores of all the West-Indian islands, particularly Jamaica. This is a most curious species, supporting a broad fleshy substance on the extremity of each branch, divided into cells like the comb of bees; each of which is occupied by a distinct animal of the polype kind. See the figure in the engraving, at fig. 6, with a nest of insects of the polype kind in the extremity of each branch.

The MOP-LIKE CORALLINE, *C. peniculum*.

Specific character, a single membranaceous wrinkled stem, on the top of which is a full tuft of jointed dichotomous branches, resembling a mop. This is the most singular of all the genus, and differs from the rest by the regular wrinkles of the stem, which is small at the base, and grows wider as it rises, till it sends forth its branches at the top; from the base it sends forth branched tubes, by which it adheres; these tubes do not lessen as they extend, but have an equal diameter their whole length. When the branches at the top are magnified, their calcareous crust, full of pores, may be distinguished. It is found in the American seas, many growing together, particularly near the Bahama islands. Shown at fig. 7.

The COMMON CORALLINE, *C. officinalis*.

This is trichotomous, or dividing in threes, with the joints of the stem a little compressed, and not unlike a wedge; those of the branches are cylindrical, and those of the ends often terminating in little knobs. It is found on the sea-coasts of England, and almost on every shore, growing in clustered tufts, from two to five inches high, about the thickness of a large thread. It varies in its colour, being red, greenish, yellowish, purple, and white. This is the species frequently given in powder, as an absorbent and vermifuge; but probably without the smallest success; for it appears to have been first recommended as a speci-

fic for worms only on account of its supposed likeness to the maw or thread-worm. This is represented at fig. 9. on the Helminthology Plate V.

SERTULARIA, THE SERTULARIA.

IN this genus the animal grows in the shape of a plant, with a branched stem, producing polypes from cup-shaped mouths or cells.—There are seventy-seven species, formed into two divisions; viz. those with horny stems; and those with crustaceous stems. They are in general small; many of them minute, yet beautiful and curious. They inhabit most seas, adhering to fuci, shells, and other marine substances. One of the species is delineated in the annexed Helminthology Plate V. fig. 10. It is the *Sertularia geniculata*; taken at first by Mr. Ellis for a coralline; but it has all the characters of a true sertularia: and is furnished with vesicles or ovaries in a kind of cup-shaped denticles placed on the branches, containing eggs, or the living young. The polypes have a numerous series of exsertile tentacula, but scarcely visible to the naked eye. This figure is considerably magnified.

PENNATULA, THE SEA-PEN.

THIS singular genus, from the similarity of several of the species in their growth and form to that of a quill-feather, has acquired the popular name of *sea-pen*. The animal is not fixed, as in the preceding genera, but has the faculty of moving, supported by a bony part within, naked at the base, the upper part more or less charged with lateral ramifications, producing polypes from tubular pores, some of them very beautiful, efflorescing like a panicle of flowers.—There are eighteen species, a small one of which is exhibited in the last-mentioned Engraving, at fig. 11. viz. the *Pennatula stellifera*: it is furnished with solitary polypes towards the tip, placed on opposite sides alternately;

alternately; the stem thickened, and obtuse beneath. It inhabits the North Seas; and is generally of a flesh-colour. Some of the species emit a very splendid phosphoric light in dark nights.

HYDRA, THE POLYPE.

THIS is the last genus of the order, and contains the *polypes*, properly so called. There are only five species, all very similar, and equally endued with the power of reproduction. The animal is minute, linear, contractile, and furnished with a number of setaceous tentacula or feelers, as shown in the plate at fig. 12. They principally inhabit stagnant pools, and gently-flowing streams, in England, and most parts of Europe.

The GREY HYDRA, *H. grisea*.

This is a true polype; and is represented in the Helminthology Plate V. fig. 12, in its expanded or active state, seeking its prey. These wonderful animals, which are found in our ponds and rivers, are of a slender form, furnished round the mouth with from eight to twelve filiform tentacula, which they can wholly contract, or let fall to a great length. When in quest of food, they cement themselves by the base or tail to any convenient substance, and then expand their tentacula for the purpose of seizing their food, which, when taken hold of, they draw up to the mouth, situated at the base or root of these thread-like arms or feelers. The mouth is possessed of an expansive power, adapted to the size of its prey; and which, when swallowed, enlarges the natural size of the trunk or body, exactly similar to that of a serpent after swallowing an animal larger than itself. The common food of polypi are small water-worms, (*gordius aquaticus*,) and monoculi, vulgarly called the water-flea. These they entangle in their feelers, which they contract by twisting them
in

in a spiral form, and thus by degrees draw them up to the mouth. This curious artifice is correctly represented in the engraving; where a small water-worm is seen carried up to the mouth of the polype ready to be devoured; another is seized by different tentacula; and on the opposite side a monocus also; each of which the little voracious polype will greedily swallow in turn; and, when sated, retracts its tentacula, and retires to rest in its quiescent state, appearing like a bit of green jelly. Its young are produced by a sort of bud issuing from its sides, appearing at first like minute papillæ, till, increasing in size, they assume the appearance of the parent polype; and then, dropping off, immediately shift for themselves. But its most wonderful faculty is, that of reproducing its parts when broken off; or, if cut in pieces, each piece grows into a distinct polype.

ORDER V. INFUSORIA, OR WORMS GENERATED IN INFUSIONS.

THE individuals of this order are commonly denominated *animalcules*, because they are in general so extremely minute, as not to be cognizable to the naked eye; but have been chiefly made known to us by the powers of the microscope. By means of this noble instrument we are as it were introduced into a new world; and made acquainted with an order of beings which, from their extraordinary minuteness, must otherwise have for ever escaped our knowledge and observation. And how many kinds of these invisibles there may be, is quite unknown; for they are observed of all sizes, from those which are barely invisible, to such as resist even the action of the microscope, and under the strongest magnifier hitherto invented appear only as moving points. The smallest living creatures these instruments can show, are those which inhabit the waters; for, though animalcules equally minute, or perhaps more so, may inhabit

WORMS GENERATED IN INFUSIONS. 615

inhabit the atmosphere, or creep upon the earth, yet it is scarcely possible to obtain a view of them; whereas, water being transparent, and confining the creatures within it, we are enabled, by applying a drop of it to the lens, to discover with ease a great part of its contents, and in a space barely visible to the naked eye often perceive a thousand little animals full of life and vigour.

But in the examination and prosecution of this curious and delicate research, how many requisites are necessary, and what a variety of favourable circumstances must be seized, so as to enable us to conduct it with success!—A habit of observation acquired by long practice, suitable leisure, rigorous attention, persevering mental exertion, and, above all, inexhaustible patience!—We must be able to manage the microscope with more than common adroitness and care, so as not to crush the little creatures we wish to become acquainted with, and which will often, in spite of all our vigilance, seclude themselves from our view. Still, to judge of their habits and economy, to ascertain their figure, and demonstrate their genera and species in the scale of animated nature, we must examine them in many different ways, in various situations, and at different intervals of motion and rest; at the same time we must be correct designers, and able to trace, with fidelity and exactness, whatever the powers of the magnifier may present, as their genuine features and organization.

The *Vermes infusoria* take their name from their being found in all kinds either of vegetable or animal infusions; if seeds, herbs, or other vegetable substances, be infused in water, it will soon be filled with an indefinite number of these minute creatures. There is a prodigious variety in their forms; some appear bell-shaped; others round or oblong, without any apparent members; some resemble a bulb with a long taper tail; others are nearly spherical; the greater part
are

are vesicular and transparent. Those most generally found in ditch-water are like inflated bladders, with a small trace of intestines in the centre; the next are a flat kind, with a number of legs under their belly. In all of them motion seems to be their chief delight; they pervade with equal ease and rapidity, and in all forms and directions, the dimensions of a single drop of water, in which they find ample space for their various progressions, sometimes darting straight forward, at other times moving obliquely, then again circularly: they know how to avoid with dexterity any obstacles that might obstruct their progress.

Among animalcules, as in every other part of nature, there is constantly a certain proportion preserved between the size of the individuals and their number. There are always fewest among the larger kinds, but they increase in number as they diminish in size, till of the last, or lowest to which our powers of magnifying will reach, there are myriads to one of the larger. Like other animals, they increase in size from their birth till they have attained their full growth. When deprived of food, they grow thin and perish; and different degrees of organization are to be discovered in their structure. The birth and propagation of these microscopic animalcules is also as regular as that of the largest animals of our globe; for though their extreme minuteness prevents us, in most cases, from seeing the germ from which they spring, yet we are well assured, from numerous observations, that the manner in which they multiply is regulated by constant and invariable laws.

It is unquestionably an object of the highest admiration to have invented means for bringing creatures so imperceptible as these animalcules under our cognizance and inspection. One might well have deemed an object that was a thousand times too minute to affect our vision, as perfectly removed from human discovery; yet we have extended our sight over animals

WORMS GENERATED IN INFUSIONS. 617

ma's to whom these would be mountains. The naked eye takes in animal beings from the elephant to the mite; but below this commences a new order, reserved only for the microscope, which comprehends all those from the mite, to those many millions of times smaller; and this order cannot be said to be exhausted, if the microscope be not arrived at its ultimate state of perfection. In fact, the greater number of microscopic animalcules are of so small a size, that through a lens, whose focal distance is the tenth part of an inch, they only appear as so many points; that is, their parts cannot be distinguished, so that they appear from the vortex of that lens under an angle not exceeding the minute of a degree. If we investigate the magnitude of such an object, it will be found nearly equal to $\frac{3}{100000}$ of an inch long. Supposing, therefore, these animalcules to be of a cubic figure, that is, of the same length, breadth, and thickness, their magnitude would be expressed by the cube of the fraction $\frac{3}{100000}$, that is, by the number $\frac{27}{10000000000000}$, that is, each animalcule is equal to so many parts of a square inch. This contemplation of the animalcules has rendered the idea of indefinitely small bodies very familiar to us; a mite was formerly thought the limit of littleness, but we are not now surprized to be told of animals many millions of times smaller than a mite. These considerations are still further heightened, by reflecting on the internal structure of animalcules; for each must have all the proportion, symmetry, and adjustment, of that organized texture which is indispensably necessary for the several functions of life; and each must be furnished with proper organs, tubes, &c. for secreting the fluids, digesting its food, and propagating its species.

Minute animals proportionably exceed the larger kinds in strength, activity, and vivacity. It is well known that the spring of a flea vastly outstrips any thing animals of a greater magnitude are capable of;

the motion of a mite is much quicker than that of the swiftest race-horse. M. De L'Isle, Hist. Acad. Scienc. 1711, p. 23, has given the computation of the velocity of a little creature, so small as to be scarcely visible, which he found to run three inches in a second; supposing now its feet to be the fifteenth part of a line, it must make five hundred steps in the space of three inches, that is, it must shift its legs five hundred times in a second, or in the time of the ordinary pulsation of an artery. The rapidity with which many of the water-insects skim the surface of the fluid, and others swim in it, is astonishing; nor is the celerity of the various species of *vermes infusoria* less deserving of admiration.

It appears that Linnæus was at considerable pains in collecting every discovery made by his contemporaries in this region of invisible animals, in order to form them into that excellent arrangement under which we now find them in his *Systema Naturæ*; where they stand under the following fifteen genera.

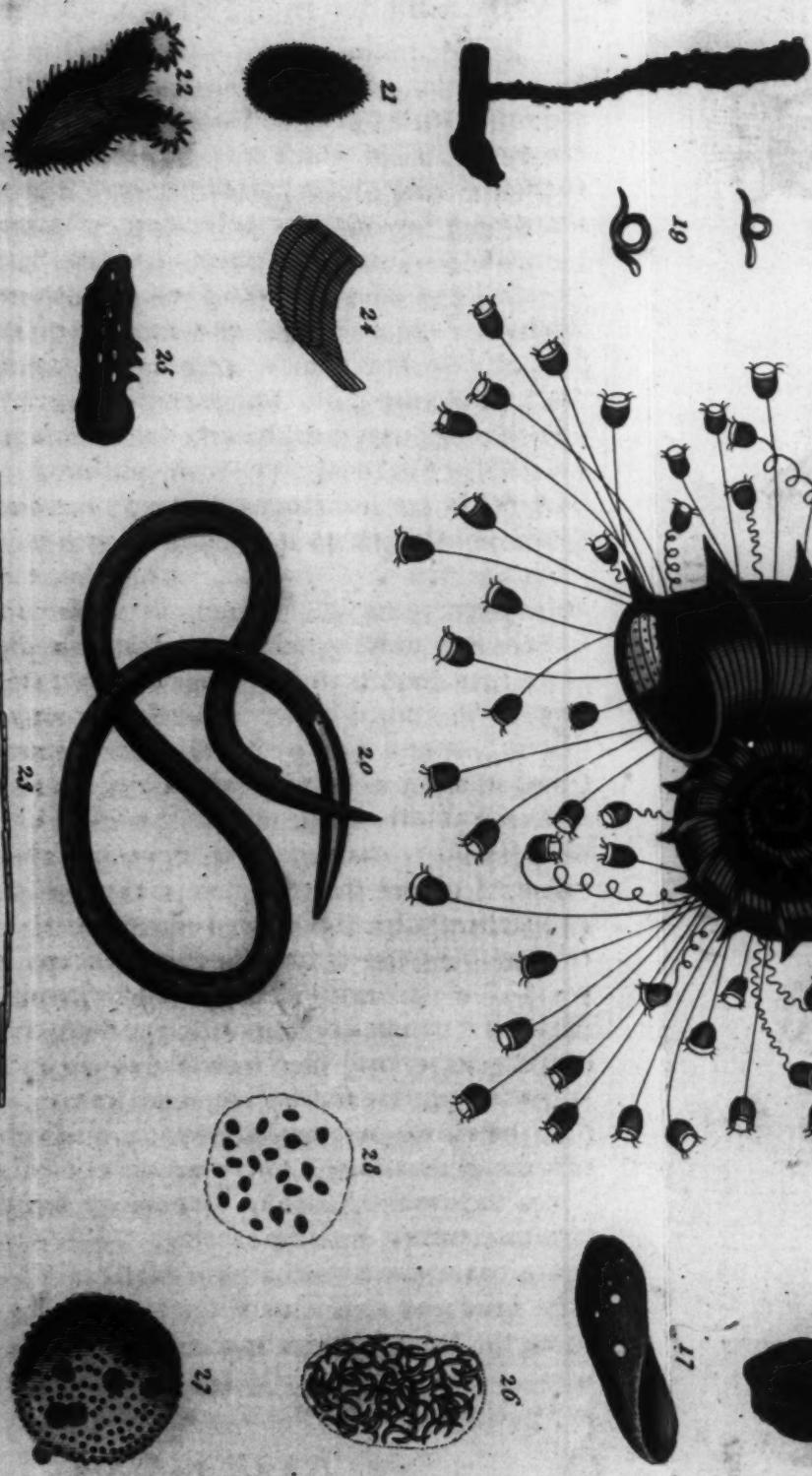
BRACHIONUS, THE BRANCHED WORM.

GENERIC characters, Animal very minute, endowed with the power of dilating and contracting its body, which is defended by a shell, and furnished with rotatory cilia. There are twelve species.

THE PITCHER-SHAPED BRACHIONUS, *Br. urceolaris*.

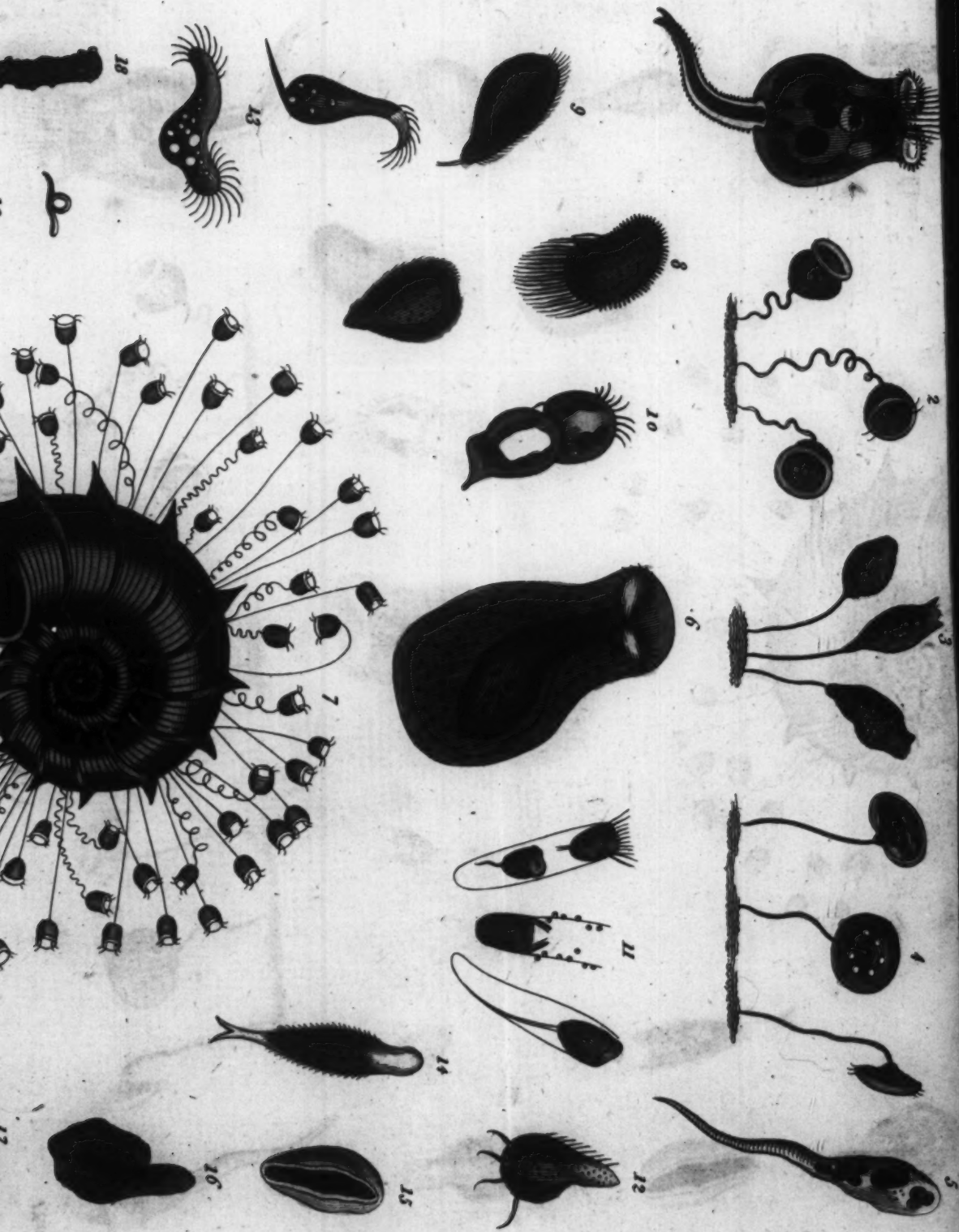
The Helminthology Plate VI. is intended to illustrate the whole of the order Infusoria. The species under consideration is shown at fig. 1. of that Plate. It is found in clear stagnant water, just visible to the naked eye, appearing like a lucid speck. Under the magnifier it appears of a greenish yellow, bell-shaped, tail long and bifid at the tip; shell toothed at the top, and rounded at the base; head furnished with double rotatory organs, which it can protrude or conceal at pleasure.

The



Infusoria or Worms generated in Infusoria.

London, Published as the act directs, July, 1786, by J. Waller.



WORMS GENERATED IN INFUSIONS. 619

The economy of this little animal may serve to elucidate that of the whole infusoria tribes. We may consider it as divided into a head, thorax, and abdomen; each of which may be extended and contracted considerably: it can, by dilating all three, protrude the head beyond the shell: or, by contracting them, draw the whole body within it. The head, when extended completely, divides the two rotatory branches; between which comes out a kind of proboscis, armed with two sets of fibrils, that appear, when at rest, like a broad point; but which can be moved to and from each other very briskly with a vibratory motion, at the will of the animal. The form and situation of the two branches are sometimes changed, the end thereof becoming more round, and the vibratory motion is then altered to a rotatory one. The thorax is annexed to the lower part of the head; it is muscular: within it there is a moving intestine, which has been supposed to be analogous to the lungs or heart. A communication is formed between the thorax and the abdomen by means of a short vessel, whose alternate contractions and dilatations occasion the abdomen to rise and fall, having at the same time a sort of peristaltic motion. The food is conveyed through this vessel into the abdomen, where it is digested; it is then discharged by the anus, which is placed near the tail. For greater strength its tail is furnished with three articulations, and is cleft or divided at the extremity, by which means it can better fasten itself to suitable objects. It is in general projected from the lower end of the shell, moving nimbly to and fro, and serving the animal as a rudder when it is swimming; but, when attached by its glutinous matter to any firm substance, it enables the animal to enjoy the full exercise of its curious rotatory motion or play. When the little creature has a mind to compose itself to rest, it contracts the head and fore part of the body, brings them down into the shell, and pulls the tail upwards, so that the

whole of the animal is contained within the shell. This valve is so transparent that the termination of the edges cannot be easily distinguished; but whatever is transacted within the shell is as plain as if there were no substance between the eye and the interior parts; insomuch that even the fibrillæ may be seen within the margin of the shell. Under a strong magnifier its ovaries are plainly distinguished at the lower part of the body, like three opaque oval spots, generally situated near the tail. From these the young ones burst into life; and it is wonderful to see them: the instant, or indeed even before, they are loosened from their integument or bag, they set their little rotatory wheels in motion, and appear to have at once all the activity and instincts of the parent worm.

These are thy glorious works, parent of good,
Almighty! Milton.

VORTICELLA, THE BELL WORM.

GENERIC characters, Animal naked, furnished with rotatory cilia, capable of contracting and extending itself. This genus contains fifty-seven species, classed in three divisions.

I. Those with the body seated on a pedicle or stem, but variously disposed; as shown in the Engraving at fig. 2, viz. *Vorticella cyathina*, cup-shaped, transparent blue, with a twisted stem, in three positions. Fig. 3, *Vorticella putrida*, oblong, pale blue, with a retractile tip and rigid stem, in three positions. Fig. 4, *Vorticella patellina*, saucer-shaped, pale-blue, with a retortile stem, in three positions: these three species are commonly found in sea-water after it has been kept standing for a few days.

II. Those furnished with a tail, as represented at fig. 5, *Vorticella flosculosa*, oblong, pale yellow, with a few opaque dots; tail pointed, and rough: found in wet senny lands; just discernible to the naked eye.

III. Those without tail or stem, as delineated at fig.

WORMS GENERATED IN INFUSIONS. 621

fig. 6, *Vorticella ampulla*, formed like an ascidia, pale yellow, contained in a bottle-shaped pellucid greenish bag; head divided into two lobes, ciliated or fringed. The bag is in the shape of a common water-bottle, enveloped in a kind of thin film or membrane; found in foul stagnant ponds.

But by far the most curious of this genus is the *Vorticella convallaria*, a species belonging to the first division, and much resembling cyathina, but clustered or gregarious; bell-shaped, with two pair of little arms, and a projectile stem. This is the species popularly known by the name of *bell-animals*; and are generally found adhering to some hard substance in the water. They are represented in the annexed Engraving at fig. 7, as found by M. Rüfel, attached to a curious *cornu ammonis*, with points projecting from the back. To the naked eye this group appeared only as so many little white specks; but under the microscope as little bells, agitating the water to a considerable distance. The stems of these have a peculiar motion: they draw themselves up and shorten all at once, taking the form of a spiral; in a moment after they again resume their former shape, stretching themselves out straight as before. Many of them may be seen at times fastened to each other by their tails; the cilia, which are two on each side of their mouth, are very seldom to be perceived.

TRICHODA, THE HAIRY WORM.

GENERIC characters, Animal invisible (to the naked eye), hairy or horned, under the microscope pellucid. This genus contains sixty species, which like the preceding are classed in three divisions.

I. Those which are covered with a soft down or hair, as shown at fig. 8, *Trichoda ciliata*, kidney-shaped, pale red; found in fresh water: or as at fig. 9, *Trichoda fulcata*, ovate, pointed at the tip, with a groove along the abdomen, ciliate on each side; of a pale-reddish

reddish colour; found between the valves of the *mytilus edulis*. Fig. 10, *Trichoda transfuga*, broadish, and pale blue; the fore-part hairy, and ciliate behind. Fig. 11, *Trichoda inquilinus*, in three positions, sheathed in a cylindrical bag, with a small pedicle within the bag, pale blue, and covered with molecules, supposed to be the ovaries. Both of these are found in seawater after being kept standing two or three days.

II. Those furnished with cirri, and called *HIMANTORUS*; exhibited at fig. 12, *Trichoda acarus*, ciliated behind, and sharp before, nearly pear-shaped, and full of black molecules; found in fresh waters; yellowish.

III. Those which are horned, and called *KERONA*, as represented in two positions, at fig. 13, *Trichoda pullaster*, body ovate, pale yellow; fore-part sinuate, with a crest in front; base with bristles or spines; ovaries distinctly on the body: found in ditches of stagnant water.

CERCARIA, THE TAILED WORM.

GENERIC characters, Animal invisible, pellucid, furnished with a tail, sometimes ending in two moveable spines. There are 13 species; one of which, *Cercaria podura*, is shown in the Engraving at fig. 14. It is a cylindrical taper worm, pale yellow, with opaque molecules on the body, and tail cleft: found in stagnant marshy waters.

BURSARIA, THE PURSE-WORM.

GENERIC characters, Membranaceous, hollow, very simple in shape. There are only three species at present known. One of these, *Bursaria duplella*, is represented at fig. 15. It is of an elliptical figure, with the edges folded over, leaving a narrow longitudinal cavity; brownish: found on duckweed.

GONIUM,

WORMS GENERATED IN INFUSIONS. 623

GONIUM, THE SEED WORM.

· **GENERIC** characters, Body very simple, invisible to the naked eye; but under the microscope appearing flat and angular, like the filaments or particles which appear in motion in the *semen masculinum*; whence the name *Gonium*, from the Greek word γόνι, semen, or seed. There are but five species.

· The BREASTPLATE SEED-WORM, *G. pectorale*.

Specific character, body quadrangular, pellucid, with sixteen spherical molecules, nearly equal in size, of a greenish colour, and set in a quadrangular membrane, like jewels, reflecting light on both sides. Its animality is evinced by its spontaneous motion, advancing alternately towards the right and left; these little bodies seem oval when in motion, and round when at rest. It is found in pure water.

The BOLSTER SEED-WORM, *G. pulvinatum*.

Specific character, body quadrangular, opaque, with four cylindrical protuberances. This appears like a little quadrangular membrane, plain on both sides; but with a large magnifier it looks like a bolster, formed of three or four cylindric pillows, flattened or sunk here and there. Thus it appeared to Müller on his first examination; some days after all the sides were plain, without any convexity, and divided into little square spaces by lines crossing each other. It is found upon dunghills.

· The TRUNCATED SEED-WORM, *G. truncatum*.

Specific character, body composed of obtuse angles, the hind-part arched. This is larger than the preceding; but its motion appears more languid; the fore-part consists of a straight line, with which the sides form obtuse angles, the ends of the sides being united by a curved line; the internal molecules are
of

of a dark green, with two little bright vesicles in the middle. It is found in pure water.

COLPODA, THE FLAT WORM.

BODY very simple, pellucid, flat, sinuate; invisible to the naked eye. There are seven species, one of them, *Colpoda cucullus*, is exhibited in the annexed Engraving at fig. 16. It is of an ovate figure, with an irregular margin, the top bent into a kind of beak; the membrane pale blue, filled with about twenty-four bright molecules: found in vegetable infusions.

PARAMECIUM, THE SMOOTH WORM.

BODY very simple, pellucid, flat, oblong; invisible to the naked eye.—In this genus there are seven species; one of which, *Paramecium chrysalis*, is correctly represented in the Engraving at fig. 17. It is longitudinally plaited on the fore-part, and obtuse behind; the margins filled with opaque globules, which are the ovaries or embryos of this tribe of invisibles: found in putrid salt water; pale red.

CYCLIDIUM, THE DISCUS WORM.

BODY pellucid, flat, round or oval, and very simple. There are seven species; some of which are so excessively minute as to elude the powers of the strongest magnifier in defining their parts.

The *Cyclidium pediculus* is ascertained to be a white gelatinous worm, found on the *Hydra fusca*. This polype, in its quiescent state, is delineated in the Engraving at fig. 18, on purpose to show the congeries of these minute animalcules which seem destined to maintain their existence upon it. Inhabits England.

The *Cylidium bulla* is among the smallest of this tribe; and is also found in England, in infusions of hay. It is a very pellucid orbicular white animalculum, the edges a little darker than the rest. By the assistance of the compound microscope, some globular intestines

WORMS GENERATED IN INFUSIONS. 625

intestines of a very crystalline appearance are just perceptible in the centre of the animal.

The *Cyclidium glaucoma* is found in water that has been kept stagnant about six months. It has a pellucid oval body, with both ends plain, or an oval membrane, with a distinct well-defined edge; the intestines are so very transparent, that they can scarcely be discerned when empty, even by the most powerful magnifier: when full, they are of a green colour, and there are dark globules discoverable in the middle. In plenty of water it moves swiftly in a circular and diagonal direction; whenever it moves slowly it seems to be taking in water; the intestines are then more visible, and in a violent commotion. Two of the smaller ones may often be perceived cohering to each other, and drawing one another by turns; nor are they separated by death, for they remain united even when the water is evaporated. Those who are not familiar with these kinds of curious observations, may easily mistake the shade in a single one for a junction of two, or the junction of two for a copulation.—Some species of these, magnified, may be seen at fig. 24 of the Plate containing CURCULIO, &c. p. 120.

VIBRIO, THE NIMBLE WORM.

THIS genus consists of worms equally if not more minute than the preceding. They are linear, and possess a kind of serpentine form and motion.—Twenty species have been ascertained, found chiefly in vegetable infusions, or in foul stagnant water, or putrid vegetable matter, such as paste, vinegar, &c. One of these is exhibited in the annexed Engraving, at fig. 19; *Vibrio glutinis*, yellowish white, found in paste kept for some time; and in any sediment of wheat or other grain. Another species is given, more considerably magnified, at fig. 20, *Vibrio aceti*, found in vinegar, and other mild acids. It is of a greenish yellow, with a white line from the head to the abdomen; and its

tail is pointed, with a retractile protuberance at the base. It is very active and fertile, being both viviparous and oviparous.

LEUCOPHRA, THE TRANSPARENT WORM.

THIS is a genus of invisible worms of various figures, but all of them ciliate or hairy.—There are eight species; one of which, *Leucophra vesiculifera*, is delineated in the Engraving at fig. 21; it is ovate, pale blue, full of minute vesicles, and finely ciliate on the edges. Another species is shown at fig. 22, *Leucophra heteroclita*, rounded and obtuse, and furnished with a double exsertile organ, with stellate rays, ciliate on the edges; the intestines are visible through the membrane, which is pale red.

BACILLARIA, THE WAND-WORM.

OF this genus there is but one species known: the generic characters therefore will be included in the description of that species. It was first described by Muller.

The DOUBTFUL WAND-WORM, *B. paradoxa*.

Body consisting of cylindrical straw-like filaments, laid parallel to each other, but which the animal has the power of expanding and changing into various positions, yet always so as to preserve their parallelism, whether the body be lengthened, widened, or formed into a square. This singular worm is delineated in the Engraving at fig. 23, in its linear or cylindrical state; and at fig. 24, in an expanded form, which it perpetually varies while in action. It is generally of a greenish-yellow colour, and found adhering to the *Ulva latissima*.

ENCHELIS, THE SPIKED WORM.

IT is extremely difficult to form characters that will properly distinguish animalcules so very simple in form.

WORMS GENERATED IN INFUSIONS. 627

form.—The present genus contains fifteen species of invisible naked worms, mostly of a cylindrical figure, and very simple. One of them, *Enchelis truncus*, is exhibited in the Engraving at fig. 25; body pale grey, the fore-part globular, hind-part obtuse, with three denticles or toothed spines protruded upwards; beneath which are seen a number of globules, supposed to be the ovaries. Found in stagnant water.

VOLVOX, THE BAG-WORM.

THE worms of this genus are either globular, hemispherical, or lunular; very simple, and pellucid. —There are nine species, one of which, *Volvox lunula*, is delineated in the Engraving at fig. 26. It consists of a pellucid membrane or bag, pale yellow, filled with crescent-shaped molecules, and has a double motion, that of the whole mass turning slowly round, and of the molecules one among another: found in marsh water. Another species is exhibited at fig. 27, *Volvox sphaerula*, appearing as a pellucid greenish yellow membrane, filled with circular molecules; moves slowly about a quarter of the circle from right to left, and then back again from left to right. Found in stagnant waters.

MONAS, THE ROUND WORM.

THIS concluding genus is supposed to contain the minutest of all the worms hitherto investigated by naturalists. They appear but as a moving point in the water; and it was a long time before their animation could be satisfactorily ascertained.—There are five species; one of which, *Monas atomus*, is represented in the Engraving at fig. 28. It has the appearance of a light-green halo, filled with numerous pellucid atoms, with a black dot in moveable positions; and is found in sea-water after it has been kept a considerable time. —*Monas termo* is the most minute of the genus; being so extremely small and transparent, as often to

elude the most highly magnifying powers in endeavouring to render it visible, so much does it blend or assimilate with the water in which it swims.

SPERMATIC ANIMALCULES.

BESIDES the above systematic arrangement of animalcules, there has been another very singular genus, suggested by Leeuwenhoek and Hartsoeker, as pervading the *semen masculinum* of every kind of animal; an opinion which has also been warmly supported by Andry, Valisnieri, Bourguet, and other observers. The bodies of these animalcules, says Leeuwenhoek, are of an oblong oval form, with long tapering slender tails issuing from them; and, as by this shape they resemble *tadpoles*, they have been frequently called by that name; though the tails of them, in proportion to their bodies, are much longer than the tails of tadpoles are; and it is observable, that the animalcules in the semen of fishes have tails much longer and more slender than the tails of those in other animals; insomuch, that the extremity of them is not to be discerned without the best glasses, and the utmost attention. The number of these animalcules, he says, is inconceivable. On viewing with a microscope the milt or semen of a living cod-fish, innumerable multitudes of animalcules were found therein, of such a diminutive size, that he supposed at least 10,000 of them capable of being contained in the bulk of a grain of sand; whence he concludes, that the milt of this single fish contained more living animalcules than there are to be found people living in the whole world. To find the comparative size of these animalcules, Leeuwenhoek placed a hair of his head near them; which hair, through his microscope, appeared an inch in breadth; and he was satisfied, that at least 60 such animalcules could easily lie within that diameter; whence, their bodies being spherical, it follows, that 216,000 of them are about equal

equal to a globe whose diameter is the breadth of a hair. He observed, that when the water, wherewith he had diluted the semen of a cod-fish, was exhaled, the little bodies of the animalcules burst in pieces; which did not happen to those in the semen of a ram: and this he imputes to the greater firmness and consistency of the latter; as the flesh of a land-animal is more compact than fish.

These animalcules appear to be very vigorous, and tenacious of life; for they may be observed to move long after the animal from which they are taken is dead. They have this peculiarity also, that they are continually in motion, without the least rest or intermission, provided there is fluid sufficient for them to swim about in. Leeuwenhoek farther says, that, having examined the semen of a cock, he perceived a number of animals similar to river eels; but they were so minute, that 50,000 of them were not equal in bulk to a grain of sand. Of those in the semen of a rat it required many millions to make the thickness of a hair, &c. This curious observer was persuaded, that the whole substance of the semen was only a mass of animalcules. He saw these animalcules indiscriminately in the seed of men, of quadrupeds, of birds, of fishes, and even of some insects. In the seed of a grass-hopper the animalcules were long, and extremely thin. They appeared, he says, to be attached by their superior end; and the other end, which he calls their tail, had a brisk motion, like that of the tail of a serpent when its head is fixed. In the semen of young animals, when examined before they have any sexual appetite, he alleges that he saw the same minute animals, and that they had no motion: but, when the season of love arrived, the animalcules moved with great vivacity. In the semen of a male frog, he saw animalcules; but at first, they were imperfect, and had no motion: some time after, he found them alive. They were so minute, he observes, that

that 10,000 of them were only equal in bulk to a single egg of the female.

In the semen of a man, and that of a dog, he pretended to see two species of animalcules, resembling males and females. Having shut up the semen of the dog in a small vial, he says, that a great number of animalcules died the first day; that, on the second and third day, still more of them died; and that few of them were alive on the fourth day. But, having repeated this experiment on the semen of the same dog, he found, at the end of seven days, the animalcules as brisk and lively as if they had been newly extracted from the animal: and, having opened a bitch, that some time before the experiment had been three times covered by the same dog, he could not perceive, with the naked eye, any male semen in the uterus or its appendages; but, by the assistance of the microscope, he found the spermatic animals of the dog in both horns of the uterus: in that part of the uterus which is nearest the vagina he discovered great numbers; which evidently proves, says he, that the male semen enters the uterus, or, at least, that the spermatic animals of the dog had arrived there by their own motion, which enables them to pass over four or five inches in half an hour. In the uterus of a female rabbit, which had just received the male, he observed an infinite number of spermatic animals. He remarks, that the bodies of these animals are round; that they have long tails; and they often change their figure, especially when the fluid in which they swim begins to dry up.

These experiments of Leeuwenhoek were repeated by several people, who pretended to have found them exactly as above described. Mr. Andry says, that he could find no animals in the human semen previous to the age of puberty; that they exist not in the semen of very old men; that there are few of them in those who are affected with the venereal disease,

SPERMATIC ANIMALCULES. 631

eale, and that these few are in a languishing state; that none of them appear alive in impotent persons, and that the animalcules in the semen of men have a larger head than those of other animals, which corresponds, he observes, with the figure of the *fœtus* and infant; and, he adds, that those who use women too frequently have generally few or no animalcules in their semen.

The discovery of these spermatic animalcules was thought to throw some light on the mysterious affair of generation, and these minute creatures were imagined to be each of them individuals of the same species with the parent. But here the infinite number of these animalcules was an objection, and the difficulty remained as great as before; for, as every one of these animalcules behaved to be produced from a male and female, to explain their origin by animalcular generation in the same manner was only explaining generation by itself.

The act of conception is thus described by the learned Boerhaave: The male seed, which abounds with living animalcules, animated with great strength, extreme heat, and perhaps with a great quantity of animal spirits, is ejected with a violent impetuosity through the uterine orifice, which is then open, by its neck, the valvules of which are then more limber, into the matrix of the woman, which is then swelled by motion, by heat, and becomes turgid by a sort of slight inflammation which seems to take place; moistened also by its lymph and the spirits which are excited, the excitation produced in the nervous papillæ of the wrinkles of the vagina, causes the womb to close immediately and spasmodically. The male semen being then retained, heated, agitated, meeting with the ovum of the woman its vivifying portion, which is of inconceivable smallness, insinuates itself through the pores, already dilated, of the little glandulous membrane of the egg, where it is retained, fixed,

fixed, cherished by a gentle heat, nourished, takes root by the umbilical membrane, and soon suffocates or destroys all the other animalcules which have less strength. Thus is conception completed; but, as it sometimes happens that more than one of these animalcules is preserved, hence plural conceptions; hence two children, by this internal struggle, are sometimes born joined together. *Boerh. Inst. Med. 673.*

This hypothesis, however, not proving satisfactory, another was suggested by M. Buffon, by which indeed, he at once annihilates the whole animalcular world; yet in this he was followed by several very ingenious philosophers. His system being founded upon a vast number of experiments, we shall give the particulars of a few of them in his own words:

“Having procured the seminal vessels of a man who died a violent death, and whose body was still warm, I extracted all the liquor from them, and put it in a vial. I examined by the microscope, a drop of this liquor, without any dilution. As soon as the vapours which arose from the liquor, and obscured the glass were dissipated, I observed pretty large filaments, which, in some places, spread out into branches, and, in others, intermingled with each other. These filaments clearly appeared to be agitated with an internal undulatory motion, like hollow tubes, which contained some moving substance. I saw distinctly two of these filaments, which were joined longitudinally separate from each other in the middle, and alternately approach and recede, like two stretched cords, fixed by the ends, and drawn asunder at the middle. These filaments were composed of globules which touched one another, and resembled a chaplet of beads. I then observed filaments which were blown up, and swelled in certain places, and perceived small oval globules issue from these swelled parts, which had a vibratory motion, like that of a pendulum. These small bodies were attached to the filaments by little threads,

SPERMATIC ANIMALCULES. 633

threads, which gradually lengthened as the bodies moved: and, lastly, I observed these small bodies detach themselves entirely from the large filament, and draw after them the little thread, which resembled a tail. As the liquor was too thick, and the filaments too near each other, I diluted another drop with pure rain water, after satisfying myself that it contained no animalcules. I then perceived that the filaments were more distant from each other, and saw distinctly the motion of the small bodies above taken notice of, which was more free, and they appeared to swim with greater agility, and trailed their threads after them with greater ease; and, if I had not seen them separate from the filaments, and draw the threads out of them, I should have believed, from this second observation, the moving bodies to be real animals, and their threads to be tails. After examining with great attention one of the filaments, which was three times thicker than the small bodies, I perceived two of these bodies detach themselves with much difficulty, and drag after them long slender threads, which impeded their motion. When the seminal liquor became more fluid, the filaments disappeared; but the small bodies were exceedingly numerous. Their motion, for the most part, resembled that of a pendulum; each of them had a long thread, from which they evidently endeavoured to disengage themselves; their progressive motion was extremely slow, during which they vibrated to the right and left. At each vibration they had a rolling unsteady motion; so that, besides their horizontal vibrations, they roll or vibrate in a vertical direction; which proves these bodies to be of a globular figure, or at least that their inferior part is not a flat base sufficiently extensive to keep them in one position. At the end of two or three hours, when the liquor was more fluid, a still greater number of these moving bodies appeared. They were then more free of incumbrances; their threads were shorter;

their progressive motion was more direct; and their horizontal vibration was greatly diminished; for, the longer the threads were, their vibratory motion was increased, and their progress forward was diminished. The vertical vibration was still apparent. In five or six hours, the liquor had almost all the fluidity it could acquire, without being decomposed. We then discovered that most of these small moving bodies were entirely disengaged from their threads. Their figure was oval; they moved forward with considerable quickness; and, by their motion backward and forward, and to every side, they had now more than ever the appearance of real animals. Those which had tails or threads sticking to them, seemed to have less vivacity than the others. Of those which had no threads, some appeared to change both their figure and their size. Some were round; but the greatest part of them were oval, and a few were thicker at the extremities than in the middle. The rolling and vibratory motions were still perceptible. In twelve hours the liquor had deposited at the bottom of the vial, a kind of gelatinous, bluish, or rather ash-coloured, substance; and the fluid that swam on the top was nearly as clear as water, only it had a tincture of blue, like water in which a small quantity of soap had been dissolved. It still, however, retained its viscosity. The little bodies, which were now entirely freed from their threads, moved with great activity on all sides, and some of them turned round their centres. Most of them were oval, though some of them were round. I have seen them change figures, and from oval become round: I have seen them divide, and, from a single oval or globule, separate into two. Their activity always increased as their size diminished. At the end of twenty-four hours the liquor had deposited a greater quantity of gelatinous matter, which I diluted, with some difficulty, in water. It appeared to consist of a multitude of opaque tubes resembling

resembling lace, but without any regularity or the smallest motion. In the clear semen itself, there were a few small bodies still moving; next day their number was still farther diminished. After this, nothing was to be seen but globules without the least appearance of motion. These experiments were often repeated with great exactness; and they convinced me that the threads which adhere to the moving bodies are not tails, nor any part proper to these bodies; for the tails or threads have no proportion to the rest of the body; they are of different dimensions, though the bodies are always nearly of the same size at the same time. The motion of the globule is embarrassed in proportion to the length of the tail. When the tail is too long, it sometimes prevents the progressive motion altogether, leaving nothing but the vibrations from right to left; and the globules make evident efforts to disentangle themselves from this incumbrance.

“ Having procured the seminal fluid of another man, recently dead, I put a pretty large drop of it on the glass of the microscope, and it soon liquefied without any mixture. It had the appearance of a close net-work, the filaments of which were of a considerable length and thickness, and they seemed to proceed from the thickest part of the liquor. These filaments separated in proportion as the liquor became more fluid; and at last they divided into globules, which seemed at first to have too little force to put them in motion: but their power of moving increased as they receded from the filaments, and they appeared to make considerable efforts to disengage themselves. In this manner each of them gradually drew tails of different lengths out of the filaments. Some of these tails were so long and so thin, that they had no proportion to the bodies, which were always more or less embarrassed, according to the length of the threads or tails. When the tail was long, the angle of the vi-

bratory motion was increased; and, when the tail was short, the progressive motion was more conspicuous. I continued my observations, almost without interruption, for fourteen hours; and I discovered, that the length of the tails or threads gradually diminished, and became so thin and delicate, that their extremities successively ceased to be visible; and, at last, the whole disappeared. The horizontal vibrations of the globules then ceased, and their progressive motion was then direct, though they still had vertical oscillations, or, rather, they rolled like a vessel at sea. The small bodies, when deprived of their tails, were oval and transparent, and resembled those pretended animals which are seen in oyster-water on the sixth or seventh day, or those found in the jelly of roasted veal at the end of the fourth day.

“ Between the tenth and twelfth hour, the liquor was become very fluid, and all the globules appeared to proceed in troops from one side of the drop. They passed over the field of the microscope in less than four seconds; they marched in lines of seven or eight in front; and succeeded each other without interruption, like the defiling of soldiers. I observed this singular phenomenon for more than five minutes; and, as the current of animals did not then cease, I was desirous of discovering the cause. I therefore gently shifted the glass, and perceived that all these moving globules proceeded from a kind of mucilage or net-work of filaments, which continually produced them, and with more rapidity and copiousness than the filaments had done ten hours before. There was still a difference more remarkable between the globules produced by the liquor, when thick, and those produced when it was more fluid: for, in the latter case, they drew no threads or tails after them, their motion was quicker, and they went in flocks like sheep. I examined the mucilage from which they proceeded for a long time, and perceived that it gradually

dually diminished, and was converted into moving globules, till more than one half of it was destroyed. After which, the liquor being too dry, this mucilage became obscure in the middle, and it was surrounded with small threads, forming square intervals. These small threads seemed to be composed of the bodies of the moving globules which had been killed by the drying of the liquor, and the whole resembled the web of a spider besprinkled with drops of dew. By the first experiments, I perceived that these small moving bodies changed their figures; and I imagined, that, in general, they diminished in bulk, though I was not then altogether certain of the fact. But my subsequent observations removed every doubt. At the twelfth and thirteenth hour, the bodies were visibly smaller; but, as they diminished in bulk, their specific gravity increased, especially when they ceased to move, which they generally did all at once, and fell down to the bottom in form of an ash-coloured sediment, which was perceptible by the naked eye; and, by the assistance of the microscope, it appeared to be composed of globules attached to one another, sometimes by threads, and at other times by groups, but always in a regular manner."

From these experiments, M. Buffon concluded, that what Leeuwenhoek, Hartsoecker, and others, have called spermatic animals, are not creatures really endowed with life, but something proper to compose a living creature: and he distinguishes them by the name of *organic particles*. The same individual kinds of animals he declares he has found in the fluids separated from the ovaria of females; and for the truth of this appeals to the testimony of Mr. Needham, who was an eye witness of his experiments. He also brings an additional proof of his doctrine from Mr. Needham's observations on the milt of the *calmar*, a species of cuttle-fish, which, he says, contains no animalcules; and therefore we may from analogy conclude,

conclude, that the small moving bodies which are to be seen in the semen of other animals, are not really creatures endowed with life. M. Buffon extends the analogy still further; and concludes, that all the moving bodies which are to be found in the infusions either of animal or vegetable substances are of a similar nature. "To discover (says he) whether all the parts of animals, and all the seeds of plants, contained moving organic particles, I made infusions of the flesh of different animals, and of the seeds of more than twenty different species of vegetables; and, after remaining some days in close glasses, I had the pleasure of seeing organic moving particles in all of them."

These systems, however, both of *spermatic animalcules*, and of *organic particles*, notwithstanding the specious mode in which they were introduced, and the credit given them by men of the first philosophical ability, are now fallen into disrepute, and totally rejected by later physiologists, for reasons which may be seen in vol. i. p. 312-329; where the true mode of generation, by *absorption*, is fully explained.



INDEX.

- A** CARUS, the Mite or Tick, 434.
ACTINIA, the Actinia, 543.
ALCYONIUM, the Alcyonium, 603; red, devil's claw, and sea-fig, 604; round, 605.
ALURNUS, large, 110.
AMMOPHILA, the Sand-wasp, 339.
AMPHITRITE, the Amphitrite, 539.
ANIMALCULES, 614—628; spermatic, or organic particles, 628.
ANOMIA, the Beaked Cockle, 576.
ANT, 66, 383; wood, and black, 386; great-headed, 387.
ANTHRENUS, 104; variegated, and black-and-yellow, 105.
ANTIPATHES, the Dark Coral, 600.
APALUS, the Apalus, 119.
APHIS, the Plant-louse, 54, 234; yarrow, rose, lime-tree, and willow, 245.
APIS, the Bee, 64, 348.
APHRODITA, the Aphrodite, 538; aculeated, 538; squamose, 539.
APTERA, 80, 424—483.
ARANEA, the Spider, 444.
ARCA, the Chest or Boat Worm, 574.
ARGONAUTA, the Argonaut, or Paper Nautilus, 578.
ASCARIS, the Intestinal Worm, 500.
ASCIDIA, the Bottle Worm, 541.
ASILUS, the Hornet-fly, ferruginous, 420; gibbous, and fork-tailed, 421.
ASTERIAS, the Star-fish, 550.
ATTELABUS, hazel, 125; weevil, birch, and bee, 126.
BACILLARIA, the Wand-worm, 626.
BARNACLE duck or goose tree, 568.
BEE, its mode of generation, 64, 349; sting, 353; queen, 356, 363; cells, 360; directions for managing, 368—379; the smooth black bee, 379; carpenter bee, 380; humble bee, 382.
BEETLE, its changes, 46; generic characters, 85; Hercules, 86; bull-comber, Caroline, and dung, 87; carnifex, and tree, 88; Goliath, 91; golden, and fulcated, 92; stag, 93; carrion, 105; shield, 107; prickly, 113; wood, 131; ground, 156; oil, 164; black, 173.
BLATTA, the Cock-roach, 170.
BLISTER-insect, or Spanish fly, 161.
BOAT-FLY, grey, 221; striated, 222.
BOMBARDIER, a species of Carabus, 157.
BOMBYLUS, the Buzz-fly, 421; common, 422.
BOSTRICHUS, the yellow-horned; 97; cylindric, and English, 98.
BRACHIONUS, the Branched Worm, 618.
BRENTUS, bearded, and anchor, 119.

BUCCINUM

- BUCCINUM**, the Whelk, 582.
BUG, common, 226; other curious species, with figures, 229; green-house, 248.
BULLA, the Dipper, 580.
BUPRESTIS, the Cow-burner, 146; large, and striped, 147; stern-horned, red, yellow, and rustic, 148; two-spotted, 149.
BURSARIA, the Purse-worm, 622.
BUTTERFLY, 271; large Indian, 276; Indian, and Asian, 277; swallow-tailed, and Siberian, 278; common, and American, 279; peacock, and admirable, 280; imperial blue, and spiral, 281.
BYRRHUS, 103; round, and varying, 104.
CALOPUS, ferrate-horned, and small, 131.
CANCER, the Crab, Lobster, &c. 461.
CANTHARIS, 137; brown, and bipustulated, 138.
CARABUS, the Ground-beetle, 156.
CARDIUM, the Cockle, 571.
CARYOPHYLLÆUS, 509.
CASSIDA, the Shield-beetle, 107; common and large, 108.
CATERPILLAR, 37; casts its skin, 38; its change to the pupa state, 41; becomes a moth or a butterfly, 43; circulation of the blood now contrary to what it was before, 44; anatomy of, 54-61.
CELLEPORA, the Cellepore, 599.
CERAMBYX, long-limbed, 127; leathery, and gigantic, 128; deer-horned, and cinnamon, 129; musk, and long-horned, 130; pimples, and porter, 131.
CERCARIA, the Tailed Worm, 599.
CHALCIS, the Newt-fly, 341; bee-like, and annulated, 342.
CHAMA, the Chama, 573.
CHERMES, 246; pear, and box, 247; alder, 248.
CHITON, the Chiton, 567.
CHRYSID, the Golden-fly, 342.
CHRYSOMELA, 111; poplar, 112.
CICADA, the Flea-locust, or Frog-hopper, 215; horned, 216; spotted, noisy, and red-bellied, 217; classical, 218; frothy, 219; woolly, 220; green, 221.
CICINDELA, the Sparkler, 145.
CIMEX, the Bug, 225.
CLAVA, the Clubbed Worm, 543.
CLIO, the Clio, 546.
COCCINELLA, the Ladybird, 108.
COCCUS, 248; wandering, 249; grass, and Polish, 257; mailed, 267; minute, 268.
COCHINEAL insect, 260.
COCKCHAFER, 88.
COCKROACH, 170; gigantic, 171; American and common, 173.
COLEOPTERA, 46, 76, 85-169.
COLPODIA, the Flat Worm, 624.
CONOPS; the Conic-faced fly, 419; long-headed, 420.
COKUS, the Cone, 579.
CORAL, fishing for, 592; dark, and black, 600; red, 601; white, and warty, 602; small, 607.
CORALLINA, the small coral, 607; trident, cock's comb, and conglutinated, 609; fan, graniferous, and fleshy, 610; mop-like, and common, 611.

CRAB,

- CRAB, 461; red mottled, 463; crested, 464; large eatable, 465; soldier, 468; hermit, 469; land, 470.
 CRAB-LOUSE, 431.
 CRANE-FLY, 398; long-legs, and saffron, 339; pot-herb, spinning, and plumed, 400; moth, 401.
 CRICKET, mole, 183; long-horned, and house, 184; field, 186; membranous, 188.
 CRYPTOCEPHALUS, 112; long-legged, and narrow, 113.
 CUCUJUS, flat, 136; blue, 137.
 CUCULLANUS, the Hooded Worm, 509.
 CULEX, the Gnat, 411.
 CURCULIO, the Weevil, 120.
 CUTTLE-FISH, great, 547.
 CYCLIDIUM, the Discus Worm, 624.
 CYNIPS, the Gall-insect, 53, 327.
 CYPREA, the Cowry, 580.
 DAGYSA, the Dageya, 543.
 DAY-FLY, 310; common, 313; balance, and white, 315; two-winged, and Williamson's, 316.
 DEATH-WATCH, 99.
 DENTALIUM, the Tooth-shell, 589.
 DERMESTES, 95; bacon-eater, 95; flesh-eater, dung-eater, and furniture-eater, 96.
 DERRIS, the Derris, 544.
 DIOPSIS, the Spectacle-fly, 401.
 DIPTERA, 79, 390—424.
 DIVER, 152; margined, 154; ash-coloured, 153.
 DOG-TICK, 435.
 DONAX, the Flat-sided Cockle, 573.
 DORIS, 537; sea, and clavate, 538.
 DRAGON-FLY, 51, 303; flat, Indian, and hooked, 307; great variegated, 308; maiden, and damsel, 309; long-bellied, 310.
 DYTISCUS, the Diver, 152.
 EARWIG, common, 167.
 ECHINORHYNCHUS, the Scratcher, 508; swine, 509.
 ECHINUS, the Sea Urchin, 555; esculent, 558; miliary, and angular, 559; stony and little turban, 560; great turban, 561; mamillary, 563; rose, 564; furrowed, 565.
 ELATER, the Skipper, 139.
 EMPIS, the Empis, livid, 418.
 ENCHELIS, the Spiked Worm, 626.
 EPHEMERA, the Day-fly or May-fly, 310.
 ERODIUS, tortoise, 160.
 FASCIOLA, the Gourd-worm, or Fluke, 510.
 FATHER long-legs, 399.
 FILARIA, the Thread-worm, 505; Guinea, and larva, 506.
 FLEA, common, 431; chigger, 434.
 FLUKE, or Flounder-worm, supposed to cause the rot in sheep, 510; hooded, 511.
 FLUSTRA, the Horn-wrack, or Sea-mat, 605.
 FLY, 402; blow-fly, 406; hairy, yellow, black, and worm-catcher, 407; pendulous, 408; hardy, 409; ox, 410; rain, 411.
 FORMICULA, the Earwig, 167.
 FORMICA, the Ant or Emmet, 383.
 FROG-hopper, 219.

- FULGORA**, the Lantern-fly, 212.
FURIA, the Fiend, 532.
GAD-FLY, 69; horse, 390; Lapland, 394; Zimb, or African gad-fly, 395.
GALL-INSECT, 53, 327; rose, and oak-leaf, 329; petiolous, oak-bud, and willow, 330.
GLOW-WORM, common, 133; Italian, 135.
GNAT, 65, 411; common, 413; creeping, 414.
GOAT-MOTH, 55.
GONIUM, the Seed-worm, 623.
GORDIUS, the Hair-worm, 533.
GORGONIA, the Black Coral, 601.
GRASSHOPPER, 189; netted, green, wart-eating, fighting, and prickly, 192; Indian, and long-winged, 193; long-horned, 194.
GRYLLUS, the Locust, Cricket, Grasshopper, &c. 181—212; snouted, 181; striped, crenulated, giant, two-spotted, and shagreen, 182.
GUM-LAC insect, 253.
GYRINUS, the Glimmer-Chaffer, 101.
HÆRUCÆ, the Mouse-worm, 509.
HALIOTIS, the Sea-ear, 588.
HARVEST-BUG, 437.
HELIX, the Snail, 584.
HEMEROBIUS, 320; sparkling, 321.
HEMIPTERA, 77, 169—271.
HIPPOBOSCA, the Horse-leach, 422.
HIRUDO, the Leech, 535.
HISPA, the Prickly Beetle, 113.
HISTER, one-coloured, 101.
HOLOTHURIA, the Holothuria, 545.
HORIA, 135; Tranquebar, and European, 136.
HORNET, the largest of wasps, 346.
HORSE-LEACH, common, 422; swallow, 423; sheep, 424.
HYDATIDS, a division of the Teniæ, or tape-worms, 513.
HYDRACHNÆ, the Water-mite, 439.
HYDRA, the Polype, 613.
HYDROPHYLUS, the Water-lover, 149; water-clock, 150; carabus, 152.
HYMENOPTERA, 79, 326—390.
ICHNEUMON-FLY, or caterpillar-eater, 70, 334; plant-louse, 336.
INFUSORIA, or Worms in Liquids, 490, 614—623.
INSECTS, 3—483; extremely numerous, and various in form, 3; advantages from the study of, 5; medical uses, 6; economical, 7; little noticed by ancient writers, 9; names of modern writers distinguished in this way, 10; species of insects more numerous than of plants, 14; their instinct or sense, 15; their parts, 16; head and mouth, 17; proboscis and tongue, 18; horns, 20; feelers, 21; eyes, 22; body in general, 26; wings, 27; wing-cases, 29; legs, 31; tail, 32; skin and blood, 33; transformations, 34; short-lived, 37; the pupa state, 39; the larva state, 48; imago or perfect state, 50; muscles, 56; brain, 57; spinal marrow, 58; tracheal artery, and heart, 59; œsophagus, 60; intestines, &c. 61; modes of generation, 62; particularly of the plant-lice and bees, 64; great fecundity, 66; care in depositing their eggs, 68; revivification, 73; how to form and preserve

- serve a collection, 74; classification, 75; Society for the study of, 82; writers on, 83, 85.
- INTESTINA, or Intestinal Worms, 486, 491—536.
- ISIS, the Red Coral, 599.
- ITCH-INSECT, 437.
- IULUS, 482; Indian, and sand, 483.
- KERMES insect, 249.
- LADYBIRD, 108; common, and 18-spotted, 110.
- LAMPYRIS, the Glow-worm, 133.
- LANTERN-FLY, Peruvian, 212; crowned; and Chinese, 214.
- LAPLISIA, the Sea Hare, 537.
- LEPIDOPTERA, 78, 271—303.
- LEPIS, the Acorn and Barnacle; 568.
- LEPISMA, the Lepisma, 424; wood, and jumping, 425.
- LEPTURA, the Wood-beetle, 131; water, and noon, 132.
- LERNEA, the Fish-biter, 546.
- LEUCOPHRA, the Transparent Worm, 626.
- LEUCOPSIS, the White-eye, 340; high-backed, 341.
- LIBELLULA, the Dragon-fly, 51, 303.
- LIGULA, the Bandage-worm, 508.
- LIMAX, the Slug, 536.
- LIMPET, 588; anomalous, 589.
- LINGUATULA, the Tongue-worm, 510.
- LOBARIA, the Lobed Worm, 545.
- LOBSTER, common, 465.
- LOCUST, 194; elephant, short, and crested, 206; Honduras, sickly, dotted, rough, and common, 208; variegated, noisy, musical, grasshopper, captain, and soldier, 211; flea, 215.
- LONG-HEAD, bug-like, 233.
- LOUSE, common, 429; crab, 431.
- LUCANUS, the Stag-chaffer; 92; paralleliped, 95.
- LUCERNALIA, the Lantern-Worm, 549.
- LUMBRICUS, the Earth-worm, 534.
- LYTTA, 160; vesicatorius, the blister-insect, or Spanish fly, 161.
- MACROCEPHALUS, the Long-head, 233.
- MACTRA, the Pellucid Oyster, 572.
- MADREPORA, the Madrepore, 598.
- MAMMARIA, the Nipple Worm, 543.
- MANTICORA, 159; snouted, 160.
- MANTIS, the Soothsayer, 174; giant, 175; broad, 176; Chinese, 178; leaf, and camel, 179; sacred, 180.
- MAW or thread worm, 500; large, 502.
- MEDUSA, hemispherical, 549.
- MELØE, the Blossom-eater, 164.
- MELYRIS, 98.
- MILLEPORA, the Millepore, 598.
- MITE, cheese, 435; tree, 438; insect, vegetating, and water, 439.
- MOLLUSCA, or Gelatinous Worms, 487, 536.
- MONAS, the Round Worm, 627.
- MONOCULUS, four-horned, 475; flea, 476; crab, 477.
- MORDELLA, the Nibbler, 165; armed, and yellow, 166.
- MOTH, 286; atlas, 289; moon, and peacock, 290; puss, 291; silk, 292; tiger, and brown tail, 299; elder, 300; currant, bride, and padella, 301; cloth, five-fingered, and six-fingered, 302.
- 4 M 2
- MUREX,

- MUREX, the Murex, 583.
 MUSCA, the Fly, 48, 402.
 MUTILLA, 388; scarlet, black, and yellow, 389.
 MYA, the Pearl-oyster, 569.
 MYRMELEON, the Lion-ant, 322; common, 323.
 MYTILUS, the Mussel, 577.
 MYXINE, the Hag, 533.
 NAIS, the Nais, 540.
 NAUTILUS, the Nautilus, 579.
 NECYDALIS, the Carrion-eater, 132; large, small, and blue, 133.
 NEPA, the Water Scorpion, 222.
 NEREIS, shining, 540.
 NERITUS, the Nerite, 587.
 NEUROPTERA, 78, 303—336.
 NITIDULA, ferruginous, 106.
 NOTONECTA, the Boat-fly, 221.
 NOTOXUS, 126; hog, soft, and unicorn, 127.
 OESTRUS, the Gad-fly, 69, 390.
 ONCHIDIUM, the Bengal Slug, 537.
 ONISCUS, 478; sharp-tailed, and round-tailed, 479.
 OPATRUM, 106; crenate, 107.
 ORGANIC particles, 637.
 OSTREA, the Oyster, 574.
 PANORPA, the Scorpion-fly, 323.
 PAPILIO, the Butterfly, 271.
 PARAMECIUM, the Smooth Worm, 624.
 PATELLA, the Limpet, 588.
 PAUSUS, small-headed, 114; horned, 115.
 PEDICELLARIA, the Stalked Worm, 544.
 PEDICULUS, the Louse, 428.
 PENNATULA, the Sea-Pen, 612.
 PHALÆNA, the Moth, 44, 55, 286.
 PHALANGIUM, long-legged, 441; spider, and crab-like, 442;
 kidney-shaped, and tailed, 443.
 PHOLAS, the Borer, 569.
 PHRYGANEÆ, 317; double-tailed and large, 318; rhombic, and
 jumping, 319.
 PHYSSOPHORA, the Physiphora, 550.
 PIMELIA, ominous, 159.
 PINNA, the Nacre, 578.
 PLANARIA, the Flat Worm, 535.
 PLANT-LOUSE, 54; its curious mode of production, 64.
 PNEUMORA, 174.
 PODURA, the Spring-tail, 426.
 POLYPE, 613.
 PRAWN, 474.
 PTEROTRACHEA, the Finned Worm, 544.
 PTINUS, 98.
 PULEX, the Flea, 431.
 RAPIDIA, serpent, and spotted, 326.
 RHINOMACER curculioides, 125.
 SABELLA, the Sand-worm, 591.
 SALPA, the Stock-worm, 542.
 SAND-WASP, 339.
 SAW-FLY, thighed and yellow, 331; willow, and elder, 332.
 SCALLOP, or peccen, 574; sea-weed, 575.

- SCARABÆUS, the Beetle, 85.
 SCOLEX, the Fish-worm, 507.
 SCOLIA, 339; four-spotted, 340.
 SCOLOPENDRA, the Centipede, 430; forked, 481; biting, 482.
 SCORPIO, the Scorpion, 459; African, and Italian, 461.
 SCORPION-FLY, common, and Greek, 325.
 SCYLLÆA, the Scyllæa, 546.
 SEPIA, the Cuttle-fish, 547.
 SERPULA, the Serpula, 590.
 SERROPALPUS, striated, 138; smooth, 139.
 SERTULARIA, the Sertularia, 612.
 SHEEP-TICK, 424.
 SHRIMP, 474.
 SILK-WORM, its various changes, 44; silk-vessels, 61; general history, 292.
 SILPHA, the Carrion-beetle, 105.
 SIPUNCULUS, the Tube Worm, 535.
 SIREX, the Tailed Wasp, 332; giant, 333; pigmy, 334.
 SKIPPER, 139; fan-horned, and shining, 140; rusty, and furrowed, 141; tessellated, banded, dark, and ferrated, 142; golden, and angulated, 143; painted, 144.
 SLUG, 536; of Bengal, 537.
 SNAIL, 584; esculent, 586; viviparous, 587.
 SOLEN, the Razor-sheath, 570.
 SPARKLER, field, 145; sylvan, 146.
 SPECTACLE-FLY, ichneumon, 401.
 SPERMATIC animalcules, 628.
 SPHEX, the Savage, 337; potter, 338; wandering, 339.
 SPHINX, the Hawk-moth, 281; eyed, 282; death's head, 283; privet, and wasp-like, 285.
 SPIDER, 65, 444; Barbary, 450; crowned, and water, 451; tarantula, 453; American, 457; prickly, 458.
 SPIO, the Tubular Worm, 539.
 SPONDYLUS, the Thorny Oyster, 573.
 SPONGIA, the Sponge, 605.
 SPRING-TAIL, rough and aquatic, 426.
 STAR-FISH, 550; Magellanic, 551; common, 552; reticulated, 554; snaky, and prickly, 555.
 STAPHILINUS, snouted, 166; red-winged, 167.
 STOMOXYS, the Stomoxys, 418; pricking, and beaked, 419.
 STROMBUS, the Strombus, 582.
 STRONGYLUS, the Lump-worm, 508.
 SYNODENDRON, 98.
 TABANUS, the Horse-fly, or Flogg, 410; ox, 410; rain, 411.
 TENIA, the Tapeworm, 512, 521.
 TAPEWORM, 521—532.
 TARANTULA, 452.
 TELLINA, the Tellina, 570.
 TENEBRIO, the Darkling, 158.
 TENTHREDO, the Saw-fly, 330.
 TEREBELLA, 539; ship, 540.
 TERMES, the White Ant, 71, 426; beating, 427.
 TESTACEA, or Testaceous Worms, 488, 566—592.
 TETHYS, the Tethys, 544.
 THRIPS, the Thrips, 269; grain, 270.
 THYNNUS,

- THYNNUS**, the Tunny-fly, 340.
TIPHIA, wasp-like, and wingless, 341.
TIPULA, the Crane-fly, 398.
TREE-MITE, 438.
TRICHOCEPHALUS, the Blunt-head, 505.
TRICHODA, the Hairy Worm, 621.
TRITOMA, two-spotted, 107.
TRITON, the Triton, 545.
TROCHUS, the Trochus, 583.
TUBIPORA, the Tubipore, 597.
TUBULARIA, the Tubularia, 606.
TURBO, the Wreath, 584.
VENUS, the Venus, 573.
VERMES, or Worms, 484 to the end.
VESPA, the Wasp, 343.
VIBRIO, the Nimble Worm, 625.
UNCINARIA, the Hook-worm, 507.
VOLVOX, the Bag-worm, 627.
VOLUTA, the Volute or Mitre, 581.
VORTICELLA, the Bell-worm, 620.
WASP, 343; common, 347; Saxon, 348.
WATER-FLEA, 102.
WATER-MITE, 439; tailed, and geographical, 440.
WATER-SCORPION, 222; large, and common, 223; lineated, 224; bug-like, 225.
WEEVIL, palm and long-legged, 120; granary, 121; nut, 122; imperial, 123; wingless, 124.
WOODLOUSE, 479; medical, 480.
WORMS, how distinguished from insects, 484; divisions, 485; Linnæan classification, 486; intestinal, 491; gelatinous, 487, 536; testaceous, 488; 566; plant-like, 490, 592; in liquids, 490, 614; seminal, 628.
ZIME, an African fly, 395.
ZONITIS, 118; pale, 119.
ZOOPHYTE, Zoophytes, or Animal Flowers, 490, 592—614.
ZYCIA, oblong, 118.



DIRECTIONS to the BINDER for placing the
COPPER-PLATES to the Twelfth and Thir-
teenth Volumes.

VOLUME THE TWELFTH.

	Page
The Land Tortoise - - -	103
The Paradoxical Frog and Surinam Toad -	193
The Cayman, or American Crocodile -	235
The Monitor Lizard - - -	242
The Great Rattle-Snake - - -	405
The Canina, or Green Boa - - -	427
The Boa Constrictor - - -	432
Egyptian Viper, Elegant Viper, Cruel Viper	454
The Lachesis, or Fatal Viper - -	456
The Clotho, or Deadly Viper - -	457
The Atropos, or Life-consuming Viper -	458
The Horned Viper - - -	479
European Viper, and the Viper of Rhedi -	488
Viper bitis, and Cobra de Monil - -	523
American Asp, and Egyptian Asp - -	526
Crotaline Viper, and Coronated Viper -	529
The Panama Viper - - -	532
The Aquatic Viper - - -	681
The Jaculus, or Dart Snake of Surinam -	696
Horned Snake, Tesselated Snake, and Annulated Snake - - -	698
Amphisbœna fuliginosa and alba - -	719

648 VOLUME THE THIRTEENTH.

The Seven Orders of Insects	- - -	Page 80
Larvæ and Pupa of the Seven Orders of Insects	- - -	81
Goliath, Carnifex, Sulcated, and Carolina, Beetles	- - -	87
Curculio, Cucujus, Cynips, Culex, and Cyclidium	- - -	120
Gigantic Cerambyx, and smaller species	- - -	128
Gryllus, Plate I.	- - -	188
Gryllus, Plate II.	- - -	192
Gryllus, Plate III.	- - -	208
Progressive Generation of the Lantern-fly.	- - -	214
Lantern-fly in its luminous state	- - -	
Different Species of the Cimex, or Bug	- - -	229
Structure and Economy of the Bee	- - -	366
The Fasciata, or Barbary Spider	- - -	450
Avicularia, Tarantula, and Aculeata, Spiders	- - -	457
Great American Spider which preys on Birds	- - -	458
Cristatus and Pagurus Crab, and Common Lobster	- - -	465
Soldier Crab, Hermit Crab, and Land Crab	- - -	468
Curious Species of Ascarides	- - -	502
Helminthology Plate II.—Hydatids	- - -	519
Helminthology Plate I.—Tapeworms	- - -	530
Aculeated and Squamose Aphrodites	- - -	539
Rare and curious species of Ascidia	- - -	541
Helminthology Plate III.—Gelatinous Worms	- - -	547
Caput Medusæ, or Magellanic Star-fish	- - -	551
Star-fish, several other species	- - -	554
Curious Species of Sea Urchin, Plate I.	- - -	558
Plate II.	- - -	562
Helminthology Plate IV.—Plant-like Worms	- - -	571
Helminthology Plate V.—Testaceous Worms	- - -	597
Gorgonia Plate I. and II.	- - -	601
Gorgonia Plate III. and IV.	- - -	602
Different species of Alcyonium	- - -	603
Seven curious Species of Corallines	- - -	609
Helminthology Plate VI.—Worms in Infusions	- - -	618
The 8vo. Plate of the Honduras Locust is to be cancelled.		

END OF THE THIRTEENTH VOLUME.

W. Lewis, Printer, Paternoster-row.

